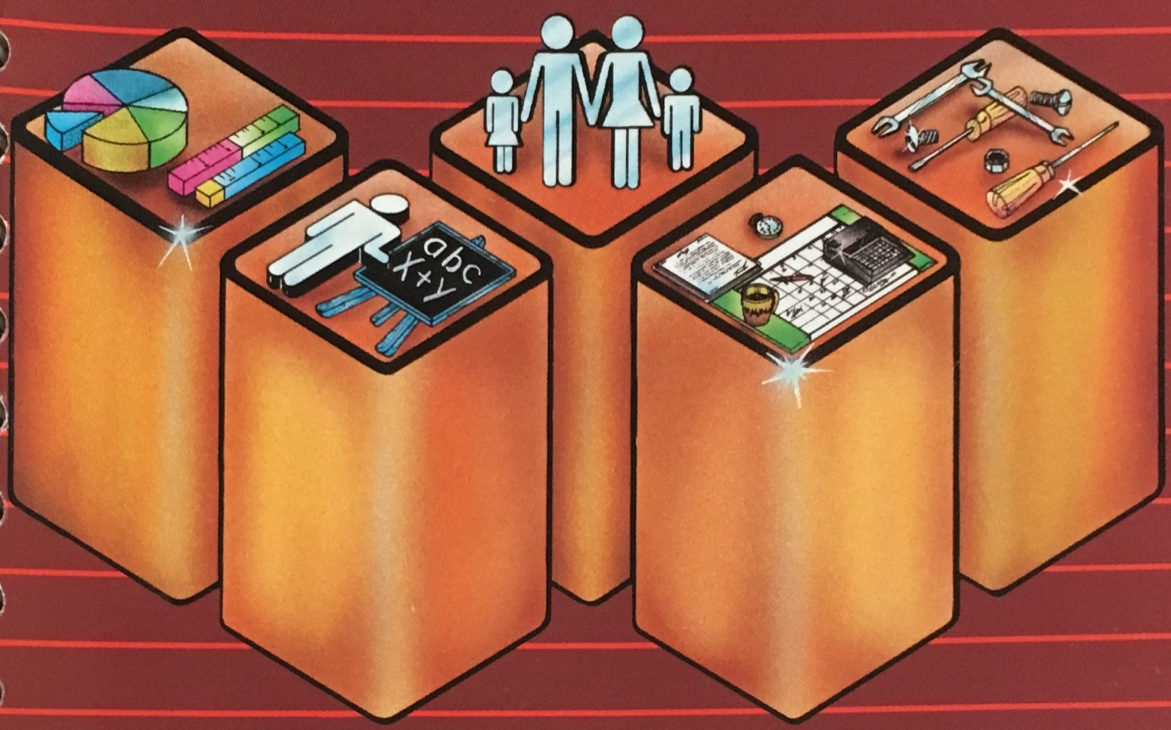
THE WIZARD'S TOOLBOX™

Assorted New Commands for Applesoft

By Peter Meyer
Craig Peterson
& Roger Wagner



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By Peter Meyer
Craig Peterson
& Roger Wagner

INSTRUCTION MANUAL

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And now on with our program!

ABOUT THE AUTHORS

Peter Meyer is a freelance software designer and was responsible for the Toolbox system concept. After he completed a 5 year honors course in Pure Mathematics and Philosophy from Monash University in Melbourne, Peter took the first flight out of Australia and has been a wanderer ever since. He studied the Buddhist culture, religion and philosophy in India and Nepal where he was an assistant to senior Tibetan Lamas. His role models include Fritz Perls, Hunter Thompson and Natty Dread.

Craig Peterson attended Iowa State University where he earned his degree in Aerospace Engineering. Craig is a professional programmer for Berol Rapidesign. He has been programming since 1974 and bought his first Apple in 1978. A Call A.P.P.L.E. article he wrote concerning Print Using led to his involvement as consultant for the original Toolbox Series product, The Wizard's Toolbox. Recognized for his clear and clever code, Craig has participated in many RWP projects including the recent work on The Write Choice. He is married, likes to tinker with his MG and plays in occasional jazz jam sessions.

Roger Wagner earned a degree in Physical Science from San Diego State University and began a career in teaching. Intrigued by the idea of personal computing, he purchased his first micro in 1978. He soon founded his own publishing company and created several popular programs for the Apple including The Write Choice and Apple Doc. Concern for the end user permeates his work and his philosophy calls for programs that both surpass industry standards and educate the user. When he isn't working on new software projects, Roger enjoys playing his guitar, amateur magic, and rock climbing.

*** THE WIZARD'S TOOLBOX ***

by Peter Meyer, Craig Peterson, and Roger Wagner

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THE WORKBENCH MAIN MENU

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INTRODUCTION

WELCOME TO THE TOOLBOX SERIES OF PROGRAMS.

The Toolbox Series is the beginning programmer's dream, but it also appeals to intermediate as well as advanced Applesoft programmers.

The Toolbox Series is a library of nifty commands which make writing ANY program in Applesoft quick and simple. It is viewed by many people as the "Applesoft Construction Set" because it allows you to build the programs you want out of an extensive set of "program building blocks" called Toolbox Files.

The Wizard's Toolbox makes writing any Applesoft program easy. With The Wizard's Toolbox, for example, if you wanted musical notes in a program you were writing, all you need to do is add the Toolbox command for tones. Then you could create almost any musical note using ONE Applesoft program line like this:

```
100 & "TONE",PITCH,DURATION
```

How does it work? That's the nice thing about the Toolbox Series; all you need to do is decide what new command you'd like to have, then use the "Workbench" to add that new command!

The Toolbox Series has many libraries in it, each of which add from 25 to 40 different commands to ordinary Applesoft BASIC.

The Wizard's Toolbox has over 30 of the most often needed commands including PRINT USING, SOUND EFFECTS, and HI-RES TEXT commands.

The Database Toolbox has over 40 array functions, including searching and sorting and different kinds of array manipulations; **The Chart 'n Graph Toolbox** has over 40 graphics and charting commands; **The Video Toolbox** has over 30 text screen input and output commands. Try one, and you'll NEVER program without your Toolbox again!

HOW TO USE THIS MANUAL

This manual may seem to be a bit large and overwhelming at first. However, after reading just a few pages that will give you an overview of the Toolbox, you should be able to do just about anything you need by

reading only a few small sections that describe the command you're interested in at the time.

The Wizard's Toolbox manual is divided into three main parts. The first is a section explaining the workings of the Toolbox Series and how to add a new command using the Workbench. The second section explains how all of the commands in the library work and how to use them. The third section is a more detailed look at the various utility functions available within the Workbench. There are also appendices describing how to create your own new Toolbox commands in the back.

The first thing to do is to make a copy of your diskette using any normal copy program. Next, boot the Wizard's Toolbox on your computer and follow the demonstration given in the next section of this manual.

When you have completed the demonstration run the demo programs on the back side of the disk to see what your new commands will do. Then go through the table of contents and look for the commands that interest you and read the sections of the manual devoted to those commands.

That's all you need to do to use The Wizard's Toolbox. The manual's appendices will describe the other slightly more advanced features of the Toolbox that may come in handy as you progress in your programming.

YOUR DISKETTE

You do not have to boot on the Wizard's Toolbox diskette to use any of the programs on the diskette. If the power was not previously on, or if you wish to install the modified DOS used on the Wizard's Toolbox diskette, you may however boot in the usual manner. This will not affect any programs you may wish to run later.

IMPORTANT: It is strongly advised that you do not use your originally purchased diskette, in either the examples that follow, or your daily use of the Wizard's Toolbox. Instead, make a back-up of your disk. The original should then be put in a safe place, and the back-up used as your work diskette. After making your work diskette, return to this section.

In addition, the backside of the Wizard's Toolbox diskette contains a number of demonstration programs, which will provide some insight as to the possible uses of the Toolbox's commands.

SPECIAL DOS FEATURES

If you do boot on the Wizard's Toolbox diskette, a special Disk Operating System (DOS) will be in effect which you may find to be of some advantage.

The first thing you will notice is a number just to the right of the 'RWP VOLUME 254' message. This is the number of free sectors remaining on the diskette being CATALOGed. A normal Apple DOS 3.3 diskette has a maximum of 496 free sectors available.

The second feature is an optional termination of the CATALOG listing at any of the pauses which usually occur when a catalog has more files than can be displayed on the screen at one time. When using the modified DOS, pressing RETURN will terminate the CATALOG listing at any pause. Pressing any other key will continue it.

A SHORT DEMONSTRATION

The primary purpose of the Wizard's Toolbox is to add new commands to your own Applesoft programs, as easily and efficiently as possible.

The Toolbox uses a utility called the Workbench to actually add the new commands to your programs. The Workbench is located on side 1 of your Wizard's Toolbox diskette. To use it, all that you have to do is:

1) Insert one special line in your program that tells Applesoft you have added some new commands to your program.

2) Use the Workbench utility to add the commands of your choice.

3) Use these commands from within your Applesoft program by using the ampersand followed by the name of the new command.

To see how this works, let's consider an actual example. Let's suppose for a moment that you would like to have some kind of musical sounds in a program you are starting to write. All you need to do is:

1. Type in FP to clear any program in memory. (If your program was already in memory, you wouldn't do this step.)

2. With the Wizard's Toolbox disk in the drive, type in **EXEC AMPERSAND SETUP**. Then type in LIST and you should see:

```
1 CALL PEEK(175) + 256 * PEEK(176) - 46
```

When your program is run this line will connect Applesoft to the various Toolbox commands you have added. (You could type this line in yourself anytime you want, but the EXEC method makes things easier.)

3. Get the Workbench installed by typing in:

```
BRUN WORKBENCH
```

After a few seconds the main menu will appear:

```
          *** TOOLBOX WORKBENCH ***

        SELECT AN OPTION:

     1. ADD A COMMAND
     2. REMOVE A COMMAND
     3. REMOVE ALL COMMANDS
     4. COPY ALL ADDED COMMANDS TO DISK
     5. RESTORE COMMANDS FROM DISK
     6. REPORT COMMANDS ADDED
     7. SEARCH FOR TOOLBOX COMMANDS
     8. DISPLAY MEMORY MAP
     0. EXIT
                              [NO COMMANDS ADDED]
```

4. Since the first thing we want to do is to add a new command to our program, press ´1´. The screen will then display:

INSERT DISK WITH TOOLBOX FILE TO BE
ADDED, THEN ENTER NAME OF FILE

(´CAT´ FOR CATALOG, <RETURN> TO QUIT)

TOOLBOX FILENAME ->

If you knew that TONE.TB was the file for the command you wanted to add at this point, you could just enter the name directly. Often you will not know the name exactly, in which case you can enter ´CAT´ to produce a catalog of the diskette. Enter ´CAT´ now. Since TONE.TB is further down the list, press the space bar (not RETURN) for the next page of the catalog, and continue until you can see TONE.TB. Now press RETURN to stop the catalog (assuming that you have booted with the Wizard´s Toolbox diskette).

5. Now type in TONE.TB as the Toolbox File to be loaded. Then press Return. Note that all Toolbox File names have a ´.TB´ suffix.

Next the screen will display:

YOUR COMMAND NAME ->

6. You must now enter the new name which you will use for this command within your program. Because the Toolbox Files themselves may have rather long names (so as to be most descriptive) you will often want to use a shorter name when using the routine from within your program. In this case, ´TONE´ will do nicely. Type in TONE as the name and press RETURN.

The Workbench will now load the TONE.TB routine, and add the command ´TONE´ to your program.

After the command is added, the program will return to the request for a new FILENAME. This is because you may want to add several commands at one time. Press RETURN alone to return to the menu at this point.

7. Now enter ´0´ and press RETURN to exit the Workbench and return to your program.

8. When using these new commands in your Applesoft programs, a special 'syntax', or command structure, is required. Each Toolbox command has either two or three parts, as follows:

The first part required is the ampersand symbol (&). You can think of this as being similar to the Control-D character needed whenever a disk command is done. The difference here is that the ampersand will call a Toolbox command.

The second item required is the command name (in quotes) for the routine you wish to call. For our example, this would be "TONE". If the command which you have just added does not require any information to be passed to it, then nothing more is required in the command.

The third item is optional, and is referred to as a "variable list". Each Toolbox command may or may not have certain pieces of information which have to be passed to it. In the case of the TONE.TB routine, this information is pitch and duration. (In the case of other commands, the variable list following the name may have a different number of variables required and use a variety of variable types.)

To use your new "TONE" command in a program, you would first determine the values for pitch (P) and duration (D), such as through an INPUT statement, and then call the command via the ampersand statement. To show how this might be done, enter the following program lines (these will now be in addition to the line #1 which was previously entered via the AMPERSAND SETUP procedure above):

```
10 INPUT "ENTER PITCH, DURATION: "; P, D
20 & "TONE", P, D
30 PRINT: GOTO 10
```

9. Now just RUN the program to try it out! Enter:

```
10,10
50,10
100,20
```

as some sample number pairs. It's that easy!

By the way, remember that, like normal Applesoft, you can use any variable names you want in calling a command. As long as you include the type of variables that the command expects, the variable name (or expression) is up to you.

YOU'RE DONE! You now have a complete program. The program can be LOADed or SAVEd just like any normal Applesoft program, and the new commands will be carried along automatically. They will remain a permanent part of your Applesoft program, unless you decide later to remove them using the Workbench "Remove a Command" option.

If you want to add more commands later, just BRUN WORKBENCH again, and add the commands you want. See the section later in this manual to determine the exact syntax for using each command.

IF IT DOESN'T WORK

In order for your program to use an added command it must meet two conditions: The ampersand must have been set up before any Toolbox command is executed in your program, and there must actually be an added Toolbox File with the name used in your command. If either of these conditions is not met, your program will probably crash or hang.

THE AMPERSAND LINK. It is good practice, when developing a program which will use Toolbox commands, to BEGIN by EXECing the AMPERSAND SETUP file. As explained earlier, this inserts a line (with line #1) in your program which tells Applesoft that you are using the Toolbox commands.

This line can occur anywhere in your program, provided that it is executed prior to the first Toolbox command. If it is not present then you'll probably get a SYNTAX ERROR when you try to use one of your new commands. If this happens when you run your program, check to make sure the ampersand setup line is present AND being executed prior to the Toolbox command.

THE TOOLBOX FILE. Another way to bomb your program is to attempt to use a Toolbox command which has not been added. In this case (assuming that the proper setup line has been inserted) your program will try to find the new command named by you among the commands added. When it doesn't find it, you will get an UNDEFINED FUNCTION error

message. You can then determine which Toolbox command is missing.

If you are sure that both the ampersand link and added command are present, then double-check the syntax (and perhaps the sample program listing) for the command as listed in the section on Toolbox Library Files in this manual.

ADDING MORE COMMANDS / RESUMING NORMAL OPERATION

If you want to add a new command right away, type in CALL 2051 to re-enter the Workbench. If you're done using the Workbench for a while and want to free up the memory normally occupied by the Workbench utility, type in: BRUN REMOVE WORKBENCH. This will remove the Workbench from memory.

The Workbench utility is required in memory only when you are adding or removing commands (or doing any of the other things that it allows you to do). It is not required to be in memory when you run your program.

After you have added a command with the Workbench, you may exit and immediately run your program (with the Workbench still present).

If you are using Hi-Res graphics you should remove the WORKBENCH. To remove it BRUN REMOVE WORKBENCH as described above and then run your program as usual. IMPORTANT: If you are using Hi-Res graphics, be sure to read the section on the MEMORY MAP option of the Workbench!

If you need to know more about the memory usage by the Toolbox and Workbench see "A Little More Detail" in Appendix A of this manual.

You've now learned most of what it takes to use and enjoy the Toolbox system. The next section describes the commands that have been included in this package. Their wide variety makes the Wizard's Toolbox of immediate value in your programming efforts.

If you are impatient and wish to get your hands on the Toolbox commands right away, then go ahead - it's quite friendly. At some time, however, the section in this manual on the complete Workbench options should be read, as it does provide much useful information on how to get the most out of this unique programming tool.

SPECIAL TIP: FAST RUN METHOD

If you have booted on the Toolbox diskette, then you can take advantage of its special DOS to make using the Workbench even easier.

This is done by using the "wild card" option built into the DOS. When typing the name of a file, you can use just the first few letters of the name followed by an equal sign ("="). For example, if you wanted to BRUN the Workbench, you could just type:

BRUN WORK=

This tells DOS to BRUN the first file in the catalog starting with the letters 'WORK'. The "=" is called a wild card because it can represent any combination of remaining letters in the name.

Because the Workbench, Ampersand Setup, and Remove Workbench are the first files on the diskette catalog, it gets even easier to use them:

To install the Workbench, just type: BRUN W=

To add the Ampersand Setup line, type: EXEC A=

To remove the Workbench, type: BRUN R=

DEMONSTRATION PROGRAMS

There are a number of demonstration programs on the back of the Wizard's Toolbox package. These were created using the Workbench to add commands from the Toolbox Files on the disk. These programs may be LISTed and studied to see exactly how the added commands are used within an Applesoft program.

IMPORTANT NOTE: The Workbench utility may be used to append ANY ampersand-called machine language routine to an Applesoft program, and is not limited to the Toolbox Files available on this Wizard's Toolbox disk or other Toolbox disks. This means it is possible to use routines that you have written yourself, or are listed in magazines. The only requirement is that the routine be location independent (i.e. it can't have JMP's and JSR's to labels within the routine itself).

>> THE WIZARD'S TOOLBOX COMMAND LIBRARY <<

The basic philosophy behind the Wizard's Toolbox disk is two fold:

First, to add commands to Applesoft that greatly simplify programming and add extreme power and speed to your programs.

Second, to provide a library of fast, easy-to-use commands that are common to many programs and which will allow you to concentrate on the specific application rather than wasting time "re-inventing the wheel" by writing, for example, yet another sort command.

GENERAL LIBRARY INFORMATION

The Wizard's Toolbox library of commands was designed to provide a general purpose "sampler" of the most often needed extensions to Applesoft BASIC. As mentioned earlier, there are many other library packages in the Toolbox Series, and as you become familiar with the system, you should look into what other new commands are available in the other packages.

THE WIZARD'S TOOLBOX: GENERAL SYNTAX AND YOU

This manual, and in particular the syntax of each command, was painstakingly designed with the programming novice in mind. The commands, however, were designed to satisfy the needs of the most demanding programmer. The syntax of all the commands parallel equivalent Applesoft commands as far as possible; differences are clearly noted in the documentation.

Take, for example, the FAST BLOAD.TB command. This command allows the use of optional variables like the DOS "BLOAD" command:

DOS Command:

```
BLOAD FILENAME,A768
```

TOOLBOX Command:

```
& "BLOAD","FILENAME",768
```

The DOS example shows that a variable has been specified, i.e. the address at which the binary file is to be loaded. A similar variable has also been specified for the Toolbox command.

The syntax of the commands, in general then, is as follows:

& "COMMAND" [,expression] and/or [,variable]

"COMMAND" is the name assigned to the command when it is added to the Applesoft program by the Workbench. Some commands have variables or expressions after the command name and some don't. Of the commands that do, commas are required after the command name to separate variables and expressions.

HOW TO USE THIS MANUAL

Each command in the Wizard's Toolbox has a section in this manual devoted exclusively to it. Each of these sections is designed to be independent of all the other sections.

The description for a command consists of five sections: Function, Syntax, Sample Statements, How to Use It and Sample Listing. When appropriate, additional sections will be included, such as Limitations, Errors, etc.

When you first read the following sections, it is suggested that you briefly skim over each entry for the various commands, generally noting the basic purpose and function of each command. This will give a quick overview of the contents and capabilities of the library.

If, after reviewing the sections, you're interested in more detail about a particular command, re-read the description of that command. After using the library commands for a time and becoming familiar with them, the quick reference section at the very end of this manual should provide the basic reminders for the syntax and name of each command as it is needed.

The "SYNTAX" section of each description uses the "metalanguage" notation used on pp. 30-35 of the Applesoft Basic Programming Reference Manual. This is done for completeness, compactness and continuity between Applesoft and "our" language! For those not inclined to use this method of explanation, complete examples are also provided.

The "How To Use" section of each description is more than just directions on how to include a command in a program. It also includes information suggesting WHEN to use a command and WHY to use it. This approach will help

the programming novice gain additional insight into the Datbase Toolbox´s many uses.

NOTES ON ARRAY SUBSCRIPTS

Upon reviewing the descriptions for the various commands you will notice a difference in how some of the commands "look" at array subscripts. In some cases, the commands deal with entire arrays, while in others, only a part of an array is specified.

In general, any command action which applies to an entire array (such as &"SORT",A$(0)) will use a dummy subscript of (0) after the variable name to indicate that the variable is indeed an array. When a range is needed to specify the starting and ending elements of the array in which the action is to be performed, then the notation "A(10) TO A(20)" would be expected, as in &"SORT",A$(10) TO A$(20).

TOOLBOX COMMANDS

The following pages detail each of the routines provided on the Wizard´s Toolbox diskette. In addition, other Toolbox Library diskettes are available which contain other new commands for Applesoft. Ask your dealer, or write Roger Wagner Publishing for more information on these packages.

Note that a number of routines introduce a new capability to Applesoft, namely, hexadecimal numbers. Most routines that allow hex numbers expect the number to be entered directly (not in string or numeric variable form). Syntax expressions involving hex numbers will always show these numbers as ´hexnum´. A hex number is defined as a dollar sign ($) followed by 1 to 4 hex digits.

One routine, XNUM.RM allows hex numbers within a string, and it that case, the string is required. The definition of a hex string for syntax expressions is ´hexstr´. A hex string must also begin with a dollar sign and be followed by 1 to 4 hex digits. All hex numbers must be in the range of $0 to $FFFF.

The length of each routine is also shown, to give you some idea of what trade offs are involved, if any, in implementing the routine. For example, PRINT USING.RM has a length of 261 bytes. This is considerably shorter

than any alternative written in Applesoft, not to mention more efficient.

In this case there is no trade off to speak of in implementing the routine. On the other hand, the ASCII SHAPES.TB character set has length of 1191 bytes, and should be considered when adding this to a program. You may find that this is sufficient to push the end of program point past the beginning of the Hi-Res page 1 display area of memory.

If you find your Hi-Res programs are getting so large as to conflict with the Hi-Res pages, you may wish to consider the Chart 'n Graph Toolbox. This package is devoted to Chart Graphics and includes an automatic "splitter routine" that will wrap an Applesoft program around the Hi-Res pages to eliminate any memory conflicts that would otherwise have occurred.

The lengths should be checked by BLOADing the actual Toolbox file for any application where an knowledge of the exact length is critical, as the lengths may vary slightly from the documentation in the event of future revisions.

>> ARRAY SEARCH.TB <<

by Peter Meyer and Craig Peterson

FUNCTION: To search a one-dimensional string array for the occurrence of a specified search string, or for the occurrence of a string standing in a certain relation to the search string.

LENGTH: 456 bytes ($1C8)

SYNTAX: &"NAME",first element to search/ element # found [,last element] ,string to search for, [char posn] [,beg byte] [,search type]

&"NAME",array svar (avar) [TO array svar (aexpr)], sexpr, [,avar] [,aexpr] [aexpr]

SAMPLE: &"ARYSRCH",A$(FE),KW$

=> Returns element of A$() in ´FE´ at which string ´KW$´ was found.

&"ARYSRCH",A$(FE) TO A$(LE),KW$,CP,BB,ST

=> Returns element of A$() in ´FE´ at which string ´KW$´ was found, when search was started at byte position ´BB´ within each string. Search type is either ´full´ or ´initial´ depending on value (0-5) of ´ST´. On return CP = position in the string at which KW$ was found.

&"ARYSRCH",A$(FE),KW$,,BB

=> Search for KW$ starting at FE-th element. Examine each element beginning with the BB-th character and going through the rest of the string. Search to the end of the array, and don´t bother to return the position at which search string found.

&"ARYSRCH",A$(FE),KW$,,,3

=> As above with the exception that no byte position is specified, and search type is to be type ´3´.

HOW TO USE IT: ARRAY SEARCH.TB allows you to search quickly through a 1-dimensional string array, not only for identical matches, but also for 'relational' matches, that is, 'greater than' or 'less than' relationships between the search string and the strings in the array.

The simplest form of the use of this command is as follows:

```
& "ARYSRCH", A$(FE), KW$
```

This may be translated as: Search through the array A$(), beginning with element A$(FE), looking for the first occurrence of KW$. (The array name, first element, and the keyword are all required in all forms of the command use.) On return, FE will be negative if KW$ was not found. Otherwise FE will be set to the index of the element in which KW$ was found.

Having found the element in which KW$ occurs, you can then display it, store it, or whatever. The command returns when it finds an occurrence of KW$, and so does not in itself return ALL occurrences of KW$ in the array A$(). This can, however, be accomplished simply by repeated uses of the command. For example, the following lines will display ALL occurrences of KW$ in an array B$ from the 1st element to the 100th (assuming that the length of B$ is at least 100):

```
200  FE = 1
205  & "ARYSRCH", B$(FE) TO B$(100), KW$:
     IF FE >= 0 THEN PRINT B$(FE):  IF
     FE < 100 THEN FE = FE + 1: GOTO 205
```

If you wish to know the position in the string at which KW$ was found then add an extra variable to the variable list, so:

```
&"ARYSRCH", A$(FE), KW$, CP
```

On return CP will be zero if KW$ was not found, otherwise it will be such that KW$ occurs at the CPth position in A$(FE) (remember that the value of FE has probably changed).

If you want to begin searching within each string from some position other than the first byte, include one more variable in the variable list, so:

```
& ARYSRCH", A$(FE), KW$, CP, BB
```

BB is the Byte-to-Begin variable, and can have a value in the range of 1 to 255.

So far all examples have been requests for a 'full' search, meaning that each string in the specified search range is examined from the BB-th character to the end of the string. Thus if we were searching for "CAT" with BB = 5 then the keyword would be found in an element such as "DOGS AND CATS" (and on return CP, if included in the variable list, would be set to 10). (KW$ = "DOG" would not be found if BB = 5.)

But perhaps we wish to know if "CAT" occurs, not just somewhere in the string at or after the BB-th byte, but SPECIFICALLY AT the BB-th byte. This is a different TYPE of search, and so we must include yet another variable in the variable list, so:

```
& "ARYSRCH", A$(FE), KW$, CP, BB, ST
```

ST is the Search Type, and can have any integer value in the range 0 - 5. ST = 0 means a full search, meaning (as explained above) that it will look through the entire string for the keyword. If ST > 0 then an 'initial' search will be done, which means that each string will be checked only as regards the substring which starts at the BB-th position (if BB = 1 then this means: the start of the string, hence 'initial search').

If ST > 0 then the command will return when it finds a substring X$ at the BB-th position in some element in the array satisfying the following:

```
If ST = 1 then X$ = KW$
If ST = 2 then X$ < KW$
If ST = 3 then X$ <= KW$
If ST = 4 then X$ > KW$
If ST = 5 then X$ >= KW$
```

These concepts are illustrated further in the ARRAY SEARCH DEMO program.

ARRAY SEARCH.TB allows you to default on variables in two ways. The first method is simply termination of the variable list before specifying all variables. All variables given must be in the correct order, but if you stop the list then the remaining variables are given their default values.

The second method is to create a null entry for a variable by omitting the variable name where it would have appeared. This allows you to default on some variables early in the list while still being able to give non-default values to variables later in the list. For example, to default on all variables except the search type one would use the command like this:

```
& "ARYSRCH", B$(I), KW$, , , ST
```

The default values for the defaultable variables are as follows:

```
LE = last element in the array
BB  =  1 (first character in each array element)
ST = 0 (full search)
```

LIMITATIONS: The relational searches mentioned above involve string comparisons only, e.g. "CAT" < "DOG". Searches which involve numerical comparisons, e.g.:

```
23 < 45 < 231
```

will function properly provided that the numbers are represented as strings left-justified with zeroes so that they have a common length, as in:

```
"0023" < "0045" < "0231"
```

The starting element must be specified as A$(FE), with FE defined appropriately. FE cannot be replaced by a number, since the command returns with a value in FE.

SAMPLE LISTING:

```
5  CALL PEEK(175) + PEEK(176)*256 - 46: TEXT:HOME
10 FOR I = 1 TO 10: FOR J = 1 TO 8
20 A$(I) = A$(I) + CHR$(48 + RND(1)*10): NEXT I
30 PRINT I; HTAB 5: PRINT A$(I): NEXT J: POKE 34,11
40 INPUT "DIGIT(S) TO FIND?   ";KW$: IF KW$ = ""
   THEN POKE 34,0: END
50 FE = 1: & "ARYSRCH", A$(FE), KW$, CP, 2:
   REM NOTE BB = 2
60 IF FE < 0 THEN PRINT "NOT FOUND";: GOTO 80
70 PRINT "FOUND";
80 HTAB 15: PRINT "FE = ";FE;"   CP = ";CP
90 PRINT: GOTO 40
```

DEMONSTRATION PROGRAM: ARRAY SEARCH DEMO

>> ARRAY1 SORT.TB <<

by Peter Meyer and Jim Shores

FUNCTION: Sorts the elements of a 1-dimensional string array, placing all empty strings at the end.

LENGTH: 260 bytes ($104)

SYNTAX: &"NAME",A$(first) TO A$(last), [position of sort field [,length of sort field [,speaker flag]]]
&"NAME",A$(avar) TO A$(aexpr) [,aexpr [,aexpr[,aexpr]]]

SAMPLE: &"SORT",A$(FE) TO A$(LE)
&"SORT",A$(FE) TO A$(LE), PF
&"SORT",A$(FE) TO A$(99), PF, LF
&"SORT",A$(19) TO A$(LE), PF, LF, SPKR

HOW TO USE IT: This command sorts strings according to the ASCII ordering (and thus to the alphabetical ordering) of characters as shown on page 94 of this manual. For example, if a string array contained the following eight strings then they would be sorted as shown:

CAT
D
DOGMA
RAT
RAT A TAT
RAT-A-TAT
RATATAT
RATS

If you have a string array B$ of length 100, then to sort the entire array simply use the command:

& "SORT", B$(0) TO B$(100)

You can sort a subrange of an array by defining FE and LE appropriately.

You might wish to sort the elements of an array on only a part of each string. For example, suppose you have an array containing strings such as:

842ROBERTS
090JONES
055SMITH
230BROWN

If you wanted to sort these strings simply on the name part then you could use the command:

```
& "SORT", A$(FE) TO A$(LE), 4
```

which means: Sort on only that part of each string beginning at the 4th character. If you wanted to sort on only the numeric part of these strings then you could use the command:

```
& "SORT", A$(FE) TO A$(LE), 1, 3
```

which means: Sort on the first three characters only.

More generally, you can sort on a particular 'field' within a string by defining PF to be the position of the field and LF to be the length of the field. (See the SORT DEMO 2 for an illustration of this technique.)

The command comes with optional sound effects in the form of clicking. In the case of sorts whose duration exceeds the average human boredom/anxiety coefficient, clicks are often entertaining and/or reassuring. The value of the final variable, SPKR, determines the presence or absence of clicks. The command will do its work silently if SPKR = 0.

You can default on the variables as shown in the sample command uses shown above. The default values are:

```
PF = 1     (first character in each string)
LF = 255   (sort on whole string)
SPKR = 1   (produces clicking)
```

Both elements in the sort range must be specified (unlike ARRAY SEARCH.TB), and the indices may be numerical variables or numbers (again unlike ARRAY SEARCH.TB, where the index of the first element must be a numerical variable).

LIMITATIONS: This is a string array sort, and will not normally work with arrays of numerical elements - but see Note (1) below.

The specification of the sort range must be such that FE <= LE. PF and LF must be > 0 and < 256, and such that PF + LF < 256.

NOTES: (1) Numbers can be sorted provided that they are represented as strings and left-justified with spaces or

zeroes so that each string (or field within a string) has the same length. (See the sample listing below.)

(2) Although the bubble sort is slow in comparison with other sorts (and is insufferably slow in BASIC), it is surprisingly fast when done in machine language. ARRAY1 SORT.TB's performance was measured using arrays of 10-character strings. The sorting times for arrays of various sizes were found to be as follows:

Number of elements in the array:	Sorting time in minutes and seconds:
125	0:02
250	0:06
500	0:23
1000	1:34
2000	6:17

These times can be confirmed using the SORT DEMO 1 program. The sorting time depends mainly on the size of the array, and very little on the size of the strings within the array. Doubling the array size has the effect of quadrupling the sorting time.

SAMPLE LISTING:

```
  1  CALL PEEK(175) + PEEK(176)*256 - 46
  5  FOR K = 1 TO 5: POKE 32,(K-1)*8: POKE 33,40-
     (K-1)*8:HOME:REM THIS HAS NOTHING TO DO
     WITH THE ACTUAL SORTING
 10  FOR I = 0 TO 9
 20  A$(I) = STR$(INT(RND(1)*1000)): REM RANDOM
     NUMBERS TO SORT
 30  A$(I) = RIGHT$("    "+A$(I),3): NEXT I:
     REM DON'T FORGET TO LEFT-JUSTIFY
 40  GOSUB 100: REM DISPLAY NUMBERS
 50  PRINT
 60  & "SORT", A$(0) TO A$(9): REM SORT 'EM!
 70  GOSUB 100: NEXT K:REM DISPLAY SORTED NUMBERS
 80  POKE 32,0: POKE 33,40:END
100  FOR I = 0 TO 9: PRINT A$(I): NEXT I: RETURN
```

DEMONSTRATION PROGRAMS: SORT DEMO 1

SORT DEMO 2

>> BINADR.TB <<

by Steve Cochard

FUNCTION: Returns the length and load address of any binary file on a disk, without loading the file.

LENGTH: 443 bytes ($1BB)

SYNTAX:
```
&"NAME",filename ,length [,load address]
&"NAME",sexpr, avar [,avar]
```

SAMPLE:
```
&"BINADR","HIRES PICTURE",L,A
&"BINADR",F$,L
```

HOW TO USE IT: Simply follow the command name with the name of the file to be read. Any string literal, variable or expression may be used to specify the file name.

Then put the variable which you wish to have set equal to the length after the file name, separated by a comma.

If you wish to determine the load address, use another numeric variable, again separated from the length variable by a comma.

LIMITATIONS: The optional load address must be specified by a numeric variable. String variables will generate a TYPE MISMATCH error. There is no provision for specifying slot, drive or volume. The last-accessed drive will thus always be selected.

SAMPLE LISTING:

```
10 CALL PEEK(175) + 256 * PEEK(176) - 46
20 &"BINADR","HIRES PICTURE",L,A
30 PRINT"LENGTH:  ";L
40 PRINT"ADDRESS: ";A
```

DEMONSTRATION PROGRAM: BLOAD/BINADR DEMO

>> BLOAD.TB <<

by Steve Cochard

FUNCTION: BLOADs binary files approximately four times faster than normal.

LENGTH: 597 bytes ($255)

SYNTAX:
```
&"NAME",filename [,address]
&"NAME",sexpr [,aexpr]
```

SAMPLE:
```
&"BLOAD","HIRES PICTURE"
&"BLOAD",F$
&"BLOAD",F$,AD
&"BLOAD",F$,8192
```

HOW TO USE IT: Simply follow the command name with the name of the file to be loaded. Any string literal, variable or expression may be used to specify the file name.

If you wish to specify a load address, use any numeric constant, variable or expression after the file name.

LIMITATIONS: The optional load address must be specified by a numeric variable. Hex numbers or string variables may not be used. (Use the XNUM.TB command if it is necessary to use hex addresses.) There is no provision for specifying slot, drive or volume. The last-accessed drive will thus always be selected.

SAMPLE LISTING:

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 HGR
20 &"BLOAD","HIRES PICTURE",8192
```

DEMONSTRATION PROGRAM: BLOAD/BINADR DEMO

>> DATA ELEMENT SELECT.TB <<

by Roger Wagner

FUNCTION: This advances the DATA pointer a given number of positions relative to its current position. This gives a random access-like aspect to DATA statements.

LENGTH: 129 bytes ($81)

SYNTAX: &"NAME",position
&"NAME",aexpr

SAMPLE: &"SELECT",X
&"SELECT",5 * N

HOW TO USE IT: This command can become a very powerful enhancement to Applesoft DATA statements depending on how it is implemented. To use it, simply follow the command name with the number of positions you would like to advance the DATA pointer. The position value may be given by a numeric constant, variable or expression.

When executed, the DATA pointer will be advanced the given number of elements from its current position. A value of ´0´ does not advance the pointer at all.

There are two main ways of using this command. The first is for replacing the usual "dummy" (and slow) FOR-NEXT loops which gobble unwanted DATA statement elements before locating the one you want. This can happen any time during a program when you want to advance the pointer to a new set of data.

The second application is done by combining this command with the standard RESTORE or the special LINE DATA RESTORE.TB command described next. By executing a RESTORE followed by the SELECT command, a given element in a DATA group can be accessed very quickly. See the sample listing for an example of this.

LIMITATIONS: The value for the number of positions to advance must be a positive number. Also, attempts to advance the pointer more positions than there are DATA elements will generate an OUT OF DATA error.

SAMPLE LISTING #1:

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 INPUT "WHICH ELEMENT TO ACCESS?";E
```

```
 20 RESTORE: &"SELECT",E: READ A$
 30 PRINT A$
 40 GOTO 10

100 DATA 0,1,2,3,4,5
```

SAMPLE LISTING #2:

```
  1 CALL PEEK(175) + 256 * PEEK(176) - 46
 10 INPUT "WHICH MONTH NUMBER ? (1-12)";N
 20 &"RESTORE",200:&"SELECT",N:READ M$
 30 PRINT "MONTH NUMBER ";N;" IS ";M$
 40 GOTO 10

100 DATA DAYS,MONDAY,TUESDAY,WEDNESDAY,
         THURSDAY, FRIDAY, SATURDAY,SUNDAY

200 DATA MONTHS,JANUARY,FEBRUARY,MARCH,APRIL,
         MAY,JUNE,JULY,AUGUST,SEPTEMBER,
         OCTOBER,NOVEMBER,DECEMBER

300 DATA DEPARTMENTS,SALES,ACCOUNTING,SHIPPING,
         RECEIVING
```

NOTE: Each data list includes a zeroth element (example "MONTHS" in line 200). Because SELECT advances the data pointer 'N' positions PAST the first (or more accurately, the "current") entry, it is necessary to provide a "dummy" data element. This actually can be viewed as something of a "feature" in that it allows you to start each data list with an identifying string, as is done in sample listing #2.

SAMPLE LISTING #3:

```
  1 CALL PEEK(175) + 256 * PEEK(176) - 46
 10 INPUT "WHICH PART NUMBER?";PT$
 20 RESTORE
 30 READ I$:IF I$ = "END" THEN PRINT "NOT FOUND":END
 40 IF I$ <> PT$ THEN &"SELECT",3:GOTO 30
 50 PRINT"PART NAME:";PN$:END
100 DATA 001A,GENERATOR,$29.95,25
110 DATA 002A,WIRE,$4.95,30
120 DATA 003A,BOLTS,$0.39,100
130 DATA END
```

NOTE: Use of "SELECT" here allows you to skip over data entries when scanning a table.

>> DATA LINE SELECT.TB <<

by Roger Wagner

FUNCTION: Performs a similar function to Applesoft's RESTORE command, with the exception that the line number to which the DATA pointer is restored can be specified.

LENGTH: 49 bytes ($31)

SYNTAX: &"NAME",line number
&"NAME",aexpr

SAMPLE: &"DATALINE",1000
&"DATALINE",100 * X

HOW TO USE IT: Using LINE DATA SELECT.TB it is possible to set up data structures within an Applesoft program where given blocks of line numbers contain distinct groups of information. When you want to access a given group, you no longer need to execute a "dummy" FOR-NEXT loop to read through all preceding entries in other DATA groups. Also, data can be added to other groups without affecting access to the group of interest.

To use this command, simply follow the command name with a numeric constant, variable or expression whose value corresponds to a line number within your program. At that point, the DATA pointer will be RESTOREd to that line number, and all successive READ statements will operate respective to that starting point.

It should also be noted that strings within DATA statements take up less memory than actual array variables (no look up table is needed).

The line number specified must exist in the program, or a UNDEFINED STATEMENT ERROR will be generated. Also, DATA statements should be on, or follow after the line number specified, or an OUT OF DATA error will occur when a READ is attempted.

SAMPLE LISTING:

```
  1 CALL PEEK(175) + 256 * PEEK(176) - 46
 10 INPUT"DATA GROUP TO PRINT?";G
 20 &"DATALINE",G * 100
 30 FOR I=1 TO 5
 40 READ A$: PRINT A$
 50 NEXT I
 60 GOTO 10

100 DATA A,B,C,D,E
200 DATA 1,2,3,4,5
300 DATA A1,B2,C3,D4,E5
```

DEMONSTRATION PROGRAM: DATA SELECT DEMO

>> ERR.TB <<

by Apple Computer and Roger Wagner

FUNCTION: This fixes the stack pointer in preparation for continuing the operation of a running Applesoft program when RESUME will not be used. It will also optionally return the error code and line number of the error.

LENGTH: 63 bytes ($3F)

SYNTAX:
```
&"NAME" [,error code [,line number]]
&"NAME" [,avar [,avar]]
```

SAMPLE:
```
&"ERR"
&"ERR",EC
&"ERR",EC,EL
```

HOW TO USE IT: When the ONERR flag has been set within an Applesoft program, any errors encountered will go to the line number specified by the ONERR statement, at which point an error handling command presumably exists. After the error has been handled, the programmer has the option of ending the program or resuming operation.

Normally, a RESUME statement is used to continue program operation. If RESUME is not used however, and the error occurred within a GOSUB or FOR-NEXT loop, problems will occur when the next RETURN or NEXT statement is encountered. This can be avoided by using the ERR.TB command at the beginning of your error handling command.

In addition, you may optionally include two other variable names after the command name. For the first numeric variable specified, the Applesoft or DOS error code will be returned in the variable given. A table of the possible error codes and their translations is given on the next page.

If the second variable is given, it will be returned with the line number on which the error occurred. This can also be rather useful. See the additional notes later in this section for an example of how this can be combined with the GOTO.TB command to create a new variation on the RESUME function of Applesoft.

LIMITATIONS: No significant limitations.

SAMPLE LISTING:

```
  1 CALL PEEK(175) + 256 * PEEK(176) - 46
 10 ONERR GOTO 10000
 20 REM: ERR OCCURS HERE

10000 &"ERR",EC,EL
10010 PRINT"ERROR CODE:";EC
10020 PRINT"ON LINE #: ";EL
10030 POKE 216,0
10040 GOTO 20
```

>> DOS AND APPLESOFT ERROR CODES <<

ERR CODE	DESCRIPTION
0	NEXT WITHOUT FOR
1	LANGUAGE NOT AVAILABLE
2,3	RANGE ERROR
4	WRITE PROTECTED
5	END OF DATA
6	FILE NOT FOUND
7	VOLUME MISMATCH
8	I/O ERROR
9	DISK FULL
10	FILE LOCKED
11	SYNTAX ERROR
12	NO BUFFERS AVAILABLE
13	FILE TYPE MISMATCH
14	PROGRAM TOO LARGE
15	NOT DIRECT COMMAND
16	SYNTAX ERROR
22	RETURN WITHOUT GOSUB
42	OUT OF DATA
53	ILLEGAL QUANTITY
69	OVERFLOW
77	OUT OF MEMORY
90	UNDEFINED SUBSCRIPT
107	BAD SUBSCRIPT
120	REDIMENSIONED ARRAY
133	DIVISION BY ZERO
163	TYPE MISMATCH
176	STRING TOO LONG
191	FORMULA TOO COMPLEX
224	UNDEFINED FUNCTION
254	BAD RESPONSE TO INPUT STATEMENT
255	CONTROL-C INTERRUPT ATTEMPTED

A VARIATION ON RESUME:

Normally when RESUME is executed, the program resumes operation at exactly the same STATEMENT where the error occurred. This is sometimes inconvenient if what you would prefer is to have the entire LINE re-executed.

For example, in this program:

```
 10 ONERR GOTO 100
 20 N = N + 1
 30 PRINT"AMOUNT OF CHECK #";N;":";:INPUT AMT(N)
 40 GOTO 20
100 RESUME
```

If a string rather than a number is entered for AMT(N), a bad response to input error (#254) would be generated. When the RESUME was executed on line 100, the program would then continue on the INPUT AMT(N) statement on line 30 WITHOUT re-printing the prompt string. By combining ERR.TB with GOTO.TB, you can make the program resume operation with the entire line on which the error occurred.

```
 10 ONERR GOTO 100
 20 N = N + 1
 30 PRINT"AMOUNT OF CHECK #";N;":";:INPUT AMT(N)
 40 GOTO 20

100 &"ERR",EC,EL
110 IF EC=254 THEN &"GOTO",EL
120 RESUME
```

In this program, if a bad response to input error occurs, line 30 will be re-run from the beginning. See the section for the GOTO.TB command for more details on that particular command.

DEMONSTRATION PROGRAM: ERR DEMO

>> ERR MSSG.TB <<

by Craig Peterson

FUNCTION: Prints the usual Applesoft or DOS error message from within a running program without halting program execution.

LENGTH: 150 bytes ($96)

SYNTAX:
```
&"NAME"
&"NAME" [, error code]
&"NAME" [, aexpr]
```

SAMPLE:
```
&"ERRMSSG"      (will print error message for
                 error code currently at
                 location 222)
&"ERRMSSG",42   (will print OUT OF DATA)
&"ERRMSSG",EC   (wIll print error message
                 associated with error code EC)
```

HOW TO USE IT: Once you have set up the Applesoft ONERR GOTO statement, when an error occurs, it is always up to the programmer to print his own error messages. Quite often this means a lot of IF-THEN testing to see what message should be printed in the event of a standard error.

ERR MSSG.TB allows you to print any standard error message from within your program. To use it, simply follow the command name with the error code appropriate to the error that occurred. You may use the ERR.TB command to retrieve the error code.

LIMITATIONS: The error code specified should be in the range of 0 to 253, and should correspond to an actual error message value. If values other than the ones specified in the chart under ERR.TB are given, partial messages may result.

No carriage return is printed after the error message, so print statements following the call will be printed immediately after the end of the previous message. This can be useful when adding text of your own to the standard message, but may cause difficulties if no carriage return is printed after the error message and a DOS command is then attempted (such as a PRINT D$; "CATALOG").

Note that messages for error codes 254 and 255 cannot be printed using this command.

SAMPLE LISTING:

```
  1 CALL PEEK(175) + 256 * PEEK(176) - 46
 10 ONERR GOTO 100
 20 FOR I=1 TO 10
 30 PRINT"VALUE FOR ITEM ";I;": ";:INPUT AMT(I)
 40 NEXT I

100 &"ERR",EC
110 &"ERR MSSG",EC:PRINT
120 RESUME
```

DEMONSTRATION PROGRAM: ERR MSSG DEMO

>> FREE SECTOR COUNT <<

by Peter Meyer

FUNCTION: Determines the number of free sectors on a disk in a selected drive.

LENGTH: 116 bytes ($74)

SYNTAX:
```
& "NAME";avar
& "NAME",avar;avar
& "NAME";(free sectors)
& "NAME",(drive #);(free sectors)
```

SAMPLE:
```
& "FSC"; FS
  & "FSC", DR; FS
```

HOW TO USE IT: If you are about to write a file to disk and you are unsure whether there is sufficient space on the disk then this command can be used to find out how many remaining sectors there are on the diskette. (4 sectors = 1K). On return, FS = the number of free sectors on the disk. You can specify the drive desired by including the 'DR' variable as shown. If this is omitted, thenthe last-accessed drive will be used.

Also, note that this command uses a semi-colon in front of the free sector count variable instead of the usual comma as in other Toolbox commands. This is for the purpose of clarifying which is the drive select variable and which is the free sector variable (especially when the drive variable is omitted from the command).

LIMITATIONS: If any disk error is encountered when the command tries to access the disk then on return the value of FS will be negative (i.e., a normal DOS error will not be generated). This routine will not work with relocated DOS.

SAMPLE LISTING:

```
 5 CALL PEEK(175) + 256 * PEEK(176) - 46
10 & "FSC";FS
20 PRINT "YOUR DISK HAS "FS" FREE SECTORS"
```

>> GOSUB.TB <<

by Bob Sander-Cederlof

FUNCTION: Allows the equivalent of Applesoft's GOSUB statement with the line number specified being given by a variable.

LENGTH: 35 bytes ($23)

SYNTAX:
```
&"NAME",line number
&"NAME",aexpr
```

SAMPLE:
```
&"GOSUB",LN
&"GOSUB",100 * LN
&"GOSUB",1000 + (X = 3.14) * 500
```

HOW TO USE IT: This can be very handy in menu commands where you want to go to a certain section of your program depending on a value entered by the user. Variable GOSUB statements are also used to set up alternative ways of processing data depending on the results of an operation.

The line number to 'GOSUB' can be specified by any numeric constant, variable or expression in the range of 0 to 65535.

For the second SAMPLE above, if LN can have values from 1 to 3, normal Applesoft would have been written:

```
10 IF LN=1 THEN GOSUB 100
20 IF LN=2 THEN GOSUB 200
30 IF LN=3 THEN GOSUB 300
```

or...

```
10 ON LN GOSUB 100,200,300
```

In the third example above, normal Applesoft would have to say:

```
10 IF X = 3.14 THEN 1500
20 GOSUB 1000
```

SAMPLE LISTING:

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 INPUT"LINE NUMBER TO 'GOSUB'?";LN
20 &"GOSUB",LN
30 END
```

(Sample Listing Continued...)

```
100 PRINT"100":RETURN
200 PRINT"200":RETURN
```

LIMITATIONS: The line number must be specified by a numeric value; strings are not allowed. If the line number specified is not in the program, an UNDEFINED STATEMENT ERROR will be generated. In addition, be you should be aware that renumber programs will not recognize the &"GOSUB/GOTO" statement (and definitely cannot handle the re-writing of any formula you may use within it), and as such you will have to recheck all of the line references of this command if you renumber a program using it. Use the Workbench SEARCH option to list all lines that use the &"GOSUB/GOTO" command.

DEMONSTRATION PROGRAM: GOSUB DEMO

>> GOTO.TB <<

by Roger Wagner

FUNCTION: Allows the equivalent of Applesoft's GOTO statement with the line number specified being given by a variable.

LENGTH: 43 bytes ($2B)

SYNTAX:
```
&"NAME",line number
&"NAME",aexpr
```

SAMPLE:
```
&"GOTO",LN
&"GOTO",100 * LN
&"GOTO",1000 + (X = 3.14) * 500
```

HOW TO USE IT and LIMITATIONS: See the section for GOSUB.TB above.

SAMPLE LISTING:

```
  1 CALL PEEK(175) + 256 * PEEK(176) - 46
 10 INPUT"LINE NUMBER TO 'GOSUB'?";LN
 20 &"GOTO",LN

100 PRINT"100":END
200 PRINT"200":END
```

>> MEMORY MOVE.TB <<

by Roger Wagner

FUNCTION: Moves (or more accurately, copies) a block of memory from one location to another.

LENGTH: 248 bytes ($F8)

SYNTAX: &"NAME",beginning of source, end of source,
beginning of destination
&"NAME",aexpr|hexnum,aexpr|hexnum,aexpr|hexnum

SAMPLE:
```
&"MOVE",4096, 8192, 16381
&"MOVE",$2000,$3FFF,$4000
&"MOVE",AD,AD+4096,$4000
```

HOW TO USE IT: To use this command, you must know the addresses of the beginning and end of the range of memory you wish to move, and the address of the beginning of the destination block.

If specifying the address(es) in decimal, you may use any numeric constant, variable, or expression in the range of -65535 to 65535.

If specifying the address(es) in hex, you must enter the number as a hex literal. Strings are not allowed, although XNUM.TB may be used to convert existing hex strings to decimal if needed, prior to calling this command. Decimal and hex notations may be freely mixed.

Memory blocks may be moved either up or down in relation to their starting position, and the beginning of the destination range may lie within the source block itself with no ill effects.

LIMITATIONS: Strings may not be used to specify hex numbers. They must be hex literals (no quotes around the number). In addition, all values whether decimal or hex, must be in the range -65535 to 65535 or $0 to $FFFF.

SAMPLE LISTING:

```
  1 CALL PEEK(175) + 256 * PEEK(176) - 46
 10 HOME:HGR2
 20 HCOLOR=3: HPLOT 0,0 TO 150,150
 30 HGR
 40 INPUT"PRESS <RETURN> TO MOVE PG2 TO PG1";I$
 50 &"MOVE",$4000,$3FFF,$2000
 60 END
```

>> PRINT USING.TB <<

by Craig Peterson

FUNCTION: Formats numeric data for screen, printer or disk file output.

LENGTH: 261 bytes ($105)

SYNTAX: &"NAME",edit string; number(s) to print
[;string suffix][;]
&"NAME",sexpr;aexpr [{,aexpr}]
[;sexpr][;]

Special Characters:

$	: fixed or floating dollar sign.
,	: fixed commas. Not printed when inappropriate.
0	: Number of places to round to when used AFTER the decimal point. Will act as a leading fill character when used BEFORE the decimal point.
*	: Fill character for unused digit positions. Often used on checks to mask leading blanks to amount.
space	: neutral position where a digit may be placed.
all others	: ´/´, ´:´, and all other characters will be used as non-replaceable characters around which the digits of the number will be filled. For example, &"PRINT","00/00/00",122581 would print as: 12/25/81

SAMPLE: &"PRINT","$, , .00";1234567.895;" TOTAL"
gives=> $1,234,567.90 TOTAL

Note that the length of the edit string (the number of spaces between the quotes) fixes the length of the print field. All numbers printed will be right justified within this field.

And here's more:

NUMBER	EDIT STRING	PRINTOUT
123.571113	" "	124
1491625.36	" "	1491625
-1827.64125	" .00"	-1827.64
11235813	"00000000000"	0011235813
-126.24	"00000"	-00126
1234567	" "	#####
3.14159265	" 0.0000"	3.1416
1.414213e-03	"0.000000000"	0.001414213
173205081	" , , "	173,205,081
113.355	" , $.00"	$113.36
2468.1012	"$, .00"	$ 2,468.10
1803.1763	"$ .00"	$ 1803.18
1215.1492	"********"	****1215
83886.08	"****,**$.00"	*$83,886.08
13.579	"TOTAL= .00"	TOTAL=13.58
120744	"00/00/00"	12/07/44
630	"TIME = 0:00"	TIME = 6:30
241752148	"000-00-0000"	241-75-2148

HOW TO USE IT: PRINT USING.TB is an excellent and very compact way of formatting numbers which would be printed by an Applesoft program. Not only can monetary amounts be done with ease, but also things like dates and social security numbers are possible using the proper edit string field.

The edit string provides a picture of the field that the number will be placed into. It can be either a string literal, string variable, or string expression.

Numbers will be placed in the edit field from right to left. A decimal point in the field defines the number of places that the number will be rounded to. Any '0's, '$'s, '*'s or blanks in the field are positions where digits of the number may be placed. All other characters are non-replaceable.

Any commas in the field will be printed if embedded in the number. Commas to the left of the number will not be printed. Any '$'s in the field will be printed as positioned, unless pushed to the left by the number, thereby giving both fixed and floating dollar sign capabilities.

The number will be rounded to the decimal accuracy specified by the edit string field. Up to 9 significant digits can be printed. If the number is too large or the field too small, the entire field will be printed as '#'s.

If you wish to print more than one number expression using the same edit string field, just separate the numbers with commas. They will then be printed on the same line, tabbed as would have happened with the normal Applesoft PRINT statement.

When converting programs which used PRINT USING in this form:

```
10 $###,###.##
20 X = 50: PRINT USING 10
```

The Toolbox PRINT USING would look like:

```
10 E$="    ,  $.00"
20 X = 50: &"PRINT USING",E$;X
```

If a semi-colon is used to terminate the numbers, then no carriage return will be printed, as occurs with the usual Applesoft PRINT statement.

Extra Tip: If you would like to have spaces in the final output string that will not be filled with numbers, try defining the space character with the statement CHR$(160), such as in:

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 N = 1234
20 E$ = "  " + CHR$(160) + "  "
30 &"PRINT USING",E$;N
```

Output: '12 34'

LIMITATIONS: PRINT USING.TB will format numeric data only, i.e. a number must follow the edit string, not another string.

SAMPLE LISTING:

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 INPUT"AMOUNT OF CHECK?";N
20 &"PRINT USING","$.00";N
```

DEMONSTRATION PROGRAM: PRINT USING DEMO

>> PTR READ.TB <<

by Roger Wagner and Craig Peterson

FUNCTION: This will read any two byte pointer in memory, and return the decimal value in a numeric variable.

LENGTH: 156 bytes ($9C)

SYNTAX:
```
&"NAME",address,variable
&"NAME",aexpr|hexnum,avar
```

SAMPLE:
```
&"PTRD",175,N
&"PTRD",AD,X
&"PTRD",$73,N
```

HOW TO USE IT: This is most useful when trying to determine the contents of the many two byte pointers that Applesoft uses to keep track of its own memory usage. To determine where one of these byte pairs is currently pointing, follow the command name with the address of the first byte in the pair.

The address may be specified in either decimal or hex notations. If decimal is chosen, follow the command name with a numeric constant, variable or expression.

If the address is to be specified in hex, simply use the hex value, beginning with a dollar sign ($) and having one to four hex digits.

After the specified address, place a real or integer variable into which the returned address is to be placed. Real variables will return with values in the range of 0 to 65535. If an integer variable is used, values over 32767 will be expressed in their negative forms. If a hex address is desired, XNUM.TB may be used to convert decimal addresses to hex if desired.

LIMITATIONS: If hex addressing is used, the address must be specified within a string. All addresses must be in the range of -65535 to 65535 or $0 to $FFFF.

SAMPLE LISTING:

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 &"PTRD",$AF,N
20 PRINT"END OF PROGRAM: ";N
30 &"XNUM",N,H$
40 PRINT"(HEX:           ";H$;")"
```

>> PTR WRITE.TB <<

by Roger Wagner

FUNCTION: Sets any two byte pointer in memory to the value or address specified.

LENGTH: 150 bytes ($96)

SYNTAX: &"NAME",addr of pointer, value to put there
&"NAME",aexpr|hexnum,aexpr|hexnum

SAMPLE: &"PTRWRT",113,32768
&"PTRWRT",$73,$1000
&"PTRWRT",$AF,V

HOW TO USE IT: Applesoft uses many two byte pairs as pointers to various important locations in memory. It is often useful to change these pointers to indicate new locations.

To write data to a byte pair, simply follow the command name with the address of the byte pair, and then the address to which the pointer is to be set.

If the address is specified in decimal, it may be any numeric constant, variable or expression in the range of -65535 to 65535.

If the address is specified in hex, it must be a series of hex digits beginning with a dollar sign and in the range of $0 to $FFFF.

LIMITATIONS: All values must be in the range of -65535 to 65535 or $0 to $FFFF.

SAMPLE LISTING:

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 PRINT CHR$(4);"BLOAD SHAPE.ASCII,A$4000"
20 &"PTRWRT",$E8,$4000: REM SET UP SHAPE TABLE
30 HGR: HCOLOR = 3: ROT = 0: SCALE = 1
40 DRAW 1 AT 100,100
```

>> RESET ONERR.TB <<

by Craig Peterson and Roger Wagner

FUNCTION: This sets the RESET vector so as to generate an Applesoft error code when RESET is pressed. If an ONERR GOTO statement is in effect, control will then pass to the error-handling command as in the case of a normal error occurrence. The command will also restore the original RESET vector when needed.

LENGTH: 149 bytes ($95)

SYNTAX: &"NAME",error code value
&"NAME",aexpr

SAMPLE: &"RESET ERR",99
&"RESET ERR",X
&"RESET ERR",0 (restores the RESET vector to normal)

HOW TO USE IT: This is used to disable the usual RESET function and to define what Applesoft error code will be generated when RESET is pressed. The value may be specified by any numeric constant, variable or expression in the range of 1 to 255. See the section on ERR.TB to avoid conflict with other already defined error codes.

If and when you want to restore the RESET vector to its original status, re-use the RESET ONERR command with a value of '0' following the command name. RESET ONERR.TB is the only Toolbox RESET command (see the others following) that remembers, and can later restore, the original RESET status. It should therefore be used in any case in which the original RESET status will be restored, even in those cases where you wish to ultimately set up RESET for a RUN or re-boot during your Applesoft program.

RESET ONERR.TB with a value of '0' is used most frequently just before ending the program and returning the user to the normal operating system. (Note that RESET NORM.TB must be used before RESTORE AMPERSAND.TB, if the latter command is also used before ending the program.)

LIMITATIONS: If an ONERR statement is not active, then RESET ONERR.TB will cause the program to halt and give the normal Applesoft prompt, as any other error would.

Depending on the error code specified though, strange error messages may result. RESET ONERR.TB should therefore always be used in conjunction with the usual ONERR GOTO error trapping commands.

SAMPLE LISTING:

```
  1 CALL PEEK(175) + 256 * PEEK(176) - 46
 10 ONERR GOTO 100
 20 &"RESET ERR",99

 40 REM YOUR PROGRAM HERE...

100 &"ERR",EC
110 IF EC = 99 THEN PRINT"DON'T PRESS RESET!": RESUME
120 &"ERR MSSG", EC: PRINT
130 POKE 216,0: &"RESET ERR",0:END
```

>> RESET RUN.TB and RESET BOOT.TB<<

by Roger Wagner and Peter Meyer

FUNCTION: These set up the RESET vector so as to either re-run the current Applesoft program when RESET is pressed, or re-boot the disk, according to which command is used.

LENGTH: RESET RUN.TB: 24 bytes ($18)
RESET BOOT.TB: 6 bytes ($06)

SYNTAX: &"NAME"

SAMPLE:
```
&"RESET RUN"
&"RESET BOOT"
```

HOW TO USE IT: These are used to set up the RESET vector so as to re-run any program currently in memory, or re-boot the computer, depending on which command is used. There are no additional variables required.

If you intend to restore the RESET vector at the end of your program, then you should also use RESET ONERR.TB, even if only once, to remember and the later restore the RESET vector. The sample listing below illustrates this technique.

LIMITATIONS: As with all commands which tamper with the RESET vector, RESET ONERR.TB should be used to restore RESET to normal operation before exiting the program.

SAMPLE LISTING:

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 &"RESET ONERR",99
20 &"RESET RUN": REM OR &"RESET BOOT"

30 REM
40 REM YOUR PROGRAM HERE...
50 REM

100 &"RESET ONERR",0 : REM RESTORES RESET
110 END
```

>> RESTORE AMPERSAND.TB <<

by Craig Peterson

FUNCTION: This will restore the ampersand vector to its original value, as it was before the Applesoft program was run.

LENGTH: 18 bytes ($12)

SYNTAX: &"NAME"

SAMPLE: &"AMP"

HOW TO USE IT: If you are using any utilities which use the ampersand vector, running one of your own programs with Toolbox commands in it will re-write that vector. When your program ends, the previously operational utility (if there was one) will no longer respond to the ampersand in the immediate mode.

To correct this, an optional procedure has been provided by way of this command. When your program first connects the ampersand vector via the hook-up on line #1, the Interface Routine stores the original value of the ampersand vector.

When you are going to END the Applesoft program, simply invoke the RESTORE AMPERSAND.TB command and the ampersand will be restored to its earlier function.

LIMITATIONS: None per se, although a fair degree of care is required in its use. If you exit a program via an error, control-C, RESET or any other manner other than the controlled (and expected) exit you previously set up, it is likely the RESTORE AMPERSAND.TB command will not be called. This would then leave the ampersand still pointing to the Interface Routine. If you were then to re-run your program, the Interface Routine would again save the current status of the ampersand, which would now point to itself. In other words, any previous ampersand related utilities would now be permanently disconnected.

NOTE: If you think you understand how the command RESTORE AMPERSAND.TB is meant to be used, then it is good practice to use it in all programs containing Toolbox commands. It MUST, however, be the LAST command used before your program ceases execution, since the use of this command disables ALL use of any further Toolbox commands.

If you use RESTORE AMPERSAND.TB, and then try to use another Toolbox command, the result will depend on the pre-RUN value of the ampersand vector, but a likely result would be a SYNTAX ERROR.

SAMPLE LISTING #1:

```
  1 CALL PEEK(175) + 256 * PEEK(176) - 46

 10 REM USUAL T.B PROGRAM HERE

100 &"AMP":END
```

You can also use RESTORE AMPERSAND.TB to "toggle", or switch back and forth, between the Toolbox ampersand commands and other ampersand-driven commands that your program may be using.

The key to the system is to remember that the 'CALL PEEK(175) + 256 * PEEK(176) - 46' statement hooks up the Toolbox commands, and the RESTORE AMPERSAND.TB command reconnects whatever previous ampersand commands (if any) existed when the CALL was done.

The technique, then, is to use the CALL statement to turn on Toolbox commands, and the RESTORE AMPERSAND.TB command to turn on your own ampersand commands. The possible approaches are illustrated in listing #2.

SAMPLE LISTING #2:

```
  1 PRINT CHR$(4);"BRUN AMPERSAND.USER.PROGRAM"
  2 REM INSTALL YOUR OWN AMPERSAND UTILITY HERE
 10 CALL PEEK(175) + 256 * PEEK(176) - 46
 11 TOOLBOX SYSTEM REMEMBERS IT
 10 REM A TOOLBOX COMMAND HERE
 20 &"AMP": REM SWITCH TO USER AMPERSAND FUNCTION
 30 &X,Y,Z : REM A USER AMPERSAND FUNCTION
 40 CALL PEEK(175) + 256 * PEEK(176) - 46
 41 REM RE-INSTALL TOOLBOX COMMANDS
 50 &"AMP": REM SWITCH TO BACK TO USER AMPERSAND
 60 &A,B,C : REM ANOTHER USER AMPERSAND FUNCTION
100 END
101 REM IN THIS SETUP, THE AMPERSAND CANNOT BE
        RETURNED TO THE NORMAL APPLESOFT CONDITION
        WHEN YOUR PROGRAM IS OVER, BECAUSE THE
        USER AMPERSAND FUNCTION CANNOT RESTORE IT
        ITSELF, AND AMPERSAND RESTORE CAN ONLY
        SWITCH BACK TO THE USER AMPERSAND FUNCTION.
```

>> SHAPE GOBBLER / SHAPE VIEWER <<

by Roger Wagner

SHAPE GOBBLER is a utility provided to convert existing Applesoft Shape Tables into usable Toolbox command files. Ordinarily, to use a shape table, one would have to go through a rather complicated procedure of loading and protecting the table in memory, setting pointers, etc. Needless to say, this makes the use of shape tables a bit inconvenient.

SHAPE GOBBLER solves this problem by processing raw shape tables into a simple ampersand callable command. Once the table has been converted, you simply load the Toolbox file like you would any other Toolbox command. When the shape 'command' is called, the shape table will then be automatically installed with all shape variables (such as SCALE, ROTATION, etc.) set to their common defaults. From that point on, you may use all the normal Applesoft Shape Table commands such as DRAW, XDRAW, ROT, SCALE, etc. with no concern to the technical details of their implementation.

TO USE SHAPE GOBBLER:

Place the Wizard's Toolbox diskette (side 1) in your drive and type in:

```
RUN SHAPE GOBBLER
```

The program will then prompt you to insert a diskette containing a known shape table. For purposes of example, you may now put the Wizard's Toolbox disk (side 2) in the drive. When it asks for the shape table name, press RETURN alone to catalog the diskette. In the second half of the listing you should see a file called SHAPE.ASCII. Enter this name and press RETURN.

The program will then prompt you to insert the diskette you want the completed Toolbox file saved on, and to specify the name to save the file under. You can give the name TEST.TB for this example. The disk will then come on for a moment. When it is completed, you will have a usable shape table file which can be easily used with the Toolbox system and any Applesoft program.

See the entry on ASCII SHAPES.TB (and other shape tables) for details on how to use shape tables within your programs.

IMPORTANT: PLEASE NOTE THE DISTINCTION BETWEEN 'RAW' SHAPE TABLES AND CONVERTED TOOLBOX FILES. SHAPE TABLES ARE DIFFICULT TO USE DIRECTLY. TOOLBOX FILES, ON THE OTHER HAND, ARE EASILY INSTALLED AND CALLED WITH A COMMAND NAME.

ONCE CONVERTED TO A TOOLBOX FILE, YOU SHOULD NOT RUN SHAPE GOBBLER A SECOND TIME ON THE FINISHED (TOOLBOX) BINARY FILE. IT IS SUGGESTED YOU USE SOME SORT OF NAMING CONVENTION TO PREVENT POSSIBLE CONFUSION. THE ONE USED ON ALL THE TOOLBOX SERIES DISKETTES IS TO USE THE PREFIX 'SHAPE.' FOR RAW SHAPE TABLES AND THE SUFFIX '.TB' FOR COMPLETED TOOLBOX FILES.

>> SHAPE TABLES IN GENERAL <<

Shape tables are a powerful potential feature of Applesoft, but are rarely implemented because of two main drawbacks.

The first drawback is the difficulty of creating them in the first place. Although the Applesoft Reference Manual provides technical information as to the details of shape tables, they are for the most part difficult to create, at least manually.

This is most easily solved by purchasing one of the several programs commercially available for creating shape tables. The Chart 'n Graph Toolbox has such a utility on it.

Even without creating your own shape tables, a number of tables are already available at little or no cost through local Apple user groups. If such a group exists in your area you may wish to inquire as to the availability of existing shape tables. These can then be converted using SHAPE GOBBLER for use with the Toolbox system in your own programs.

The second problem with shape tables is installing them in a running Applesoft program. It has already been mentioned that this is ordinarily a rather difficult task, best accomplished by more experienced programmers.

With the Toolbox system and SHAPE GOBBLER this is no longer a problem. The converted Toolbox shape files are easily put in any program in exactly the same manner as any other Toolbox file.

Once called, the shape table is installed and all normal shape table related commands work just as described in the manual.

Note that The Printographer, a full-featured Hi-Res printing utility from Roger Wagner Publishing can be used to easily print Hi-Res screens and is fully compatible with the Toolbox system.

>> USING CONVERTED SHAPE TABLES <<

Once the table is converted, consider it just like a normal Toolbox command. Use these guidelines for using them:

FUNCTION: Calling a shape table 'command' connects that particular shape table to any successive Applesoft shape table commands such as DRAW, ROT, SCALE, etc.

SYNTAX: &"NAME",number of shapes
&"NAME",avar

EXAMPLE: &"SHAPE",N

HOW TO USE IT: Simply follow the command name with a numeric variable. This variable will be filled with the value for the number of shapes in the table.

When the command is used, the associated shape table will be connected to the appropriate Applesoft pointers, and the SCALE and ROTATION variables set to 1 and 0, respectively.

The hardest part about explaining this command is that it is almost too simple!

LIMITATIONS: Virtually none. As long as you have converted a legitimate shape table using SHAPE GOBBLER everything should work just fine!

SAMPLE LISTING:

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 HGR:HCOLOR=3
20 &"SHAPE",N
30 VTAB 22:PRINT"THERE ARE ";N;" SHAPES IN THE TABLE"
40 DRAW 1 AT 140,80
```

>> SHAPE TABLE VIEWER <<

by Roger Wagner

This utility is provided to allow you to examine both 'raw' and converted shape tables. This can be useful, especially in cases where you might not even be sure if a binary file is in fact a shape table.

To use the program, insert the Wizard's Toolbox diskette (side 1) into your drive and type in: RUN SHAPE TABLE VIEWER.

The program will then present a brief explanation of its function, and then prompt you to insert a diskette containing a raw shape table or Toolbox shape file into the drive, and press a key.

The diskette will then be cataloged, at which point you can enter the name of the shape table file you wish to display. For this example, you can enter the name SHAPE.ASCII.

When the table has been loaded, the program will then present four separate displays. The first display is done with SCALE = 1 and ROT (rotation) = 0. This corresponds to the most common display method for a table.

The next two displays set ROT = 16 and ROT = 48. These correspond to rotations of 90 degrees to the right and left, primarily so that you can see if the shapes look okay in these forms. For character sets such as SHAPE.ASCII this is important when labeling graphs, etc.

The last display is with SCALE = 2. Shape tables rarely display well with SCALE equal to anything but 1, and even rotations other than 0 should be seldom used. This display is provided however, so you can see just how well the table does stand enlargement. To make things look at least a little better, the figures are actually drawn twice with a slight offset to create a more "solid" figure. You can delete line number 151 of the SHAPE TABLE VIEWER program if you do not want the overdraw done.

This program does not save any files to disk, or in any way alter shape tables viewed.

>> ASCII SHAPES.TB <<

by Stephen L. Billard

FUNCTION: This is a shape table of 95 ASCII characters used for printing text on the Hi-Res screen.

LENGTH: 1191 bytes ($4A7)

SYNTAX: &"NAME",number of shapes (always returns '95')
&"NAME",avar

SAMPLE: &"ASC",N

HOW TO USE IT: By using the 'command', the ASCII shape table is automatically connected. By DRAWing the appropriate shape number you can put any ASCII character on the screen.

By doing a FOR-NEXT loop on a string, it is possible to print a line of text to the screen. See SAMPLE LISTING #2 and the HIRES ASCII DEMO on the Wizard's Toolbox disk (side 2) for examples of how to do this.

LIMITATIONS: Attempts to draw shapes close enough to the edge of the screen so that the character goes off-screen may will result in the remainder of the shape being drawn on the opposite side of the screen. These are the same limitations as the Applesoft DRAW, etc. commands.

SAMPLE LISTING:

#1:
```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 HGR:HCOLOR=3
20 &"ASC",N
30 VTAB 22:PRINT"LETTER TO PRINT?";:GETA$:PRINT A$
40 C=ASC(A$)-32: IF C THEN DRAW C AT X,20
50 X = X + 6: GOTO 30
```

#2 (PRINTS A LINE OF TEXT):

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 HGR:HCOLOR=3
20 &"ASC",N: X=20:Y=20
30 VTAB 22:INPUT"TEXT TO PRINT?";I$
40 FOR I=1 TO LEN(I$)
50 C = ASC(MID$(I$,I,1)) - 32
60 IF C THEN DRAW C AT X,Y
70 X = X + 6: NEXT I
80 REM CHANGE 70 TO Y=Y+8:NEXT I TO PRINT VERTICALLY
```

>> GAME SHAPES.TB <<

FUNCTION: This is a short shape table of 5 shapes that can be used in a simple Hi-Res game.

LENGTH: 172 bytes ($AC)

SYNTAX: &"NAME",number of shapes (always returns ´5´)
&"NAME",avar

SAMPLE: &"DOT",N

HOW TO USE IT: By using the ´command´, the shape table is automatically connected. By DRAWing the appropriate shape number you can put any of the 5 shapes on the Hi-Res screen.

Here are the five shapes in GAME SHAPES.TB:

1 2 3 4 5

One of the most useful shapes is #1, which is just a simple dot. The power of this shape is in the ability to specify any SCALE and ROTATION value, to create a line on the Hi-Res screen with special qualities.

When you use HPLOT to draw a line on the screen, you have to know the starting and ending coordinates for the line to start and stop at.

With the DOT shape (#1), you can specify SCALE = S, where ´S´ is the desired length of the line you want to draw. ROTATION = R then determines what direction the line will be drawn in from the current Hi-Res cursor position. For any SCALE of ´5´ or more, ROTATION (the variable ´R´) may have any integer value from 0 to 64. See the Applesoft Reference Manaul for more information on the limits of the ROTATION value.

Also, when a DRAW (or XDRAW) using the DOT shape is done in Applesoft, the Hi-Res cursor will be left at the ´end´ of the line drawn, which means you can automatically then DRAW (or XDRAW) from that spot by just omitting the ´AT X,Y´ part of the command statement.

The other advantage to the DOT shape for drawing lines is that you can use XDRAW. This has the effect of

preserving the background screen information (i.e. image), so that a following XDRAW with the same SCALE and ROTATION will erase the 'ray' leaving the background in its original condition. (the normal shape table DRAW command is equivalent to an HPLOT).

Also, because you can use the Applesoft shape drawing routines, you can use the collision counter (location $EA = 234 decimal) to detect whether the 'ray' hit anything. See the SAMPLE LISTING following, and the demo program SHAPES DEMO for an example of these techniques.

SAMPLE LISTING:

```
 1  CALL  PEEK (175) + 256 *  PEEK (176) - 46
 10  HGR : HCOLOR= 3
 20  & "DOT",N: REM ALWAYS RETURNS '5'
 30  DRAW 1 AT 20,20: REM DRAW THE ROCKET
 35  DRAW 2 AT 200,90: REM DRAW THE SAUCERR
 40  VTAB 22: PRINT "USE PADDLES TO CONTROL SIZE"
 45  PRINT "AND DIRECTION OF THE 'RAY'"
 100  POKE 234,0: REM CLEAR COLLISION COUNTER
 110 R =  PDL (0) / 4:S =  PDL (1): IF S = 0 THEN S = 1
 120  ROT= R: SCALE= S
 130  XDRAW 5 AT 140,80: REM DRAW THE RAY
 140  FOR I = 1 TO 50: NEXT I: REM  LEAVE IT FOR A
      SECOND...
 150  XDRAW 5 AT 140,80: REM ERASE THE RAY
 160  IF  PEEK (234) = 0 THEN 110
 170  PRINT  CHR$ (7);"A HIT!"
 175  SCALE= 1: ROT= 0 :HCOLOR = 0
 180 X = 200:Y = 90: REM POSITION OF SAUCER
 190  IF R > 32 THEN X = 20:Y = 20: REM ROCKET
 200  FOR I = 1 TO 6: REM SOME EXPLOSION STUFF
 210  XDRAW 3 AT X,Y: XDRAW 4 AT X,Y
 220  NEXT I:REM AN EVEN NUMBER SO XDRAW'S CANCEL
 230  DRAW 3 AT X,Y:DRAW 4 AT X,Y:REM ERASE THINGS
 240  GOTO 100
```

LIMITATIONS: Only those limitations (i.e. available ROT setting, etc.) that are limits of Applesoft itself. Remember that DRAW uses the current HCOLOR, whereas XDRAW is independent of current HCOLOR and merely reverses the screen background under the shape. **Remember to remove the Workbench before using this, or any of the other, Hi-Res shape commands.**

>> MISC SHAPES.TB <<

FUNCTION: This is a shape table of 60 shapes that can be used in a variety of programs that use Hi-Res graphics.

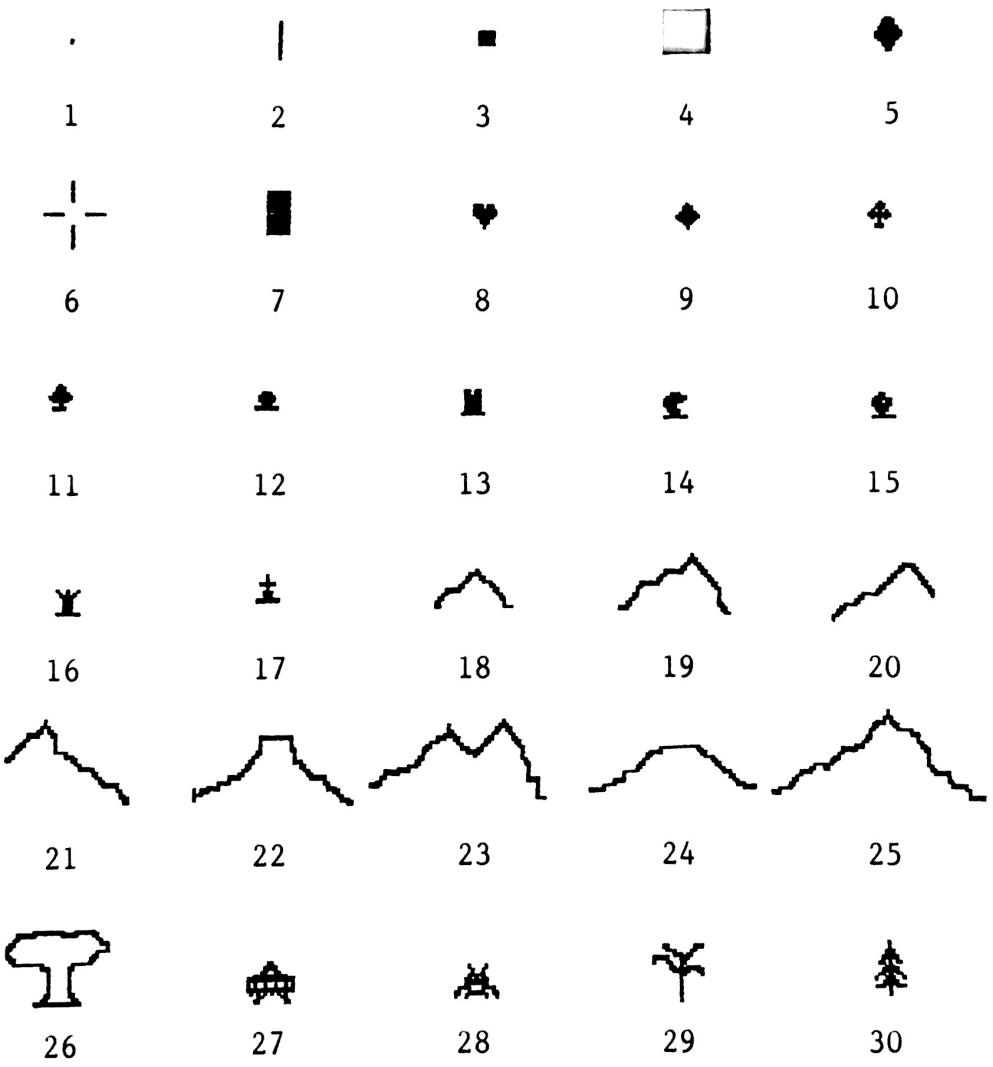
LENGTH: 3038 bytes ($BDE)

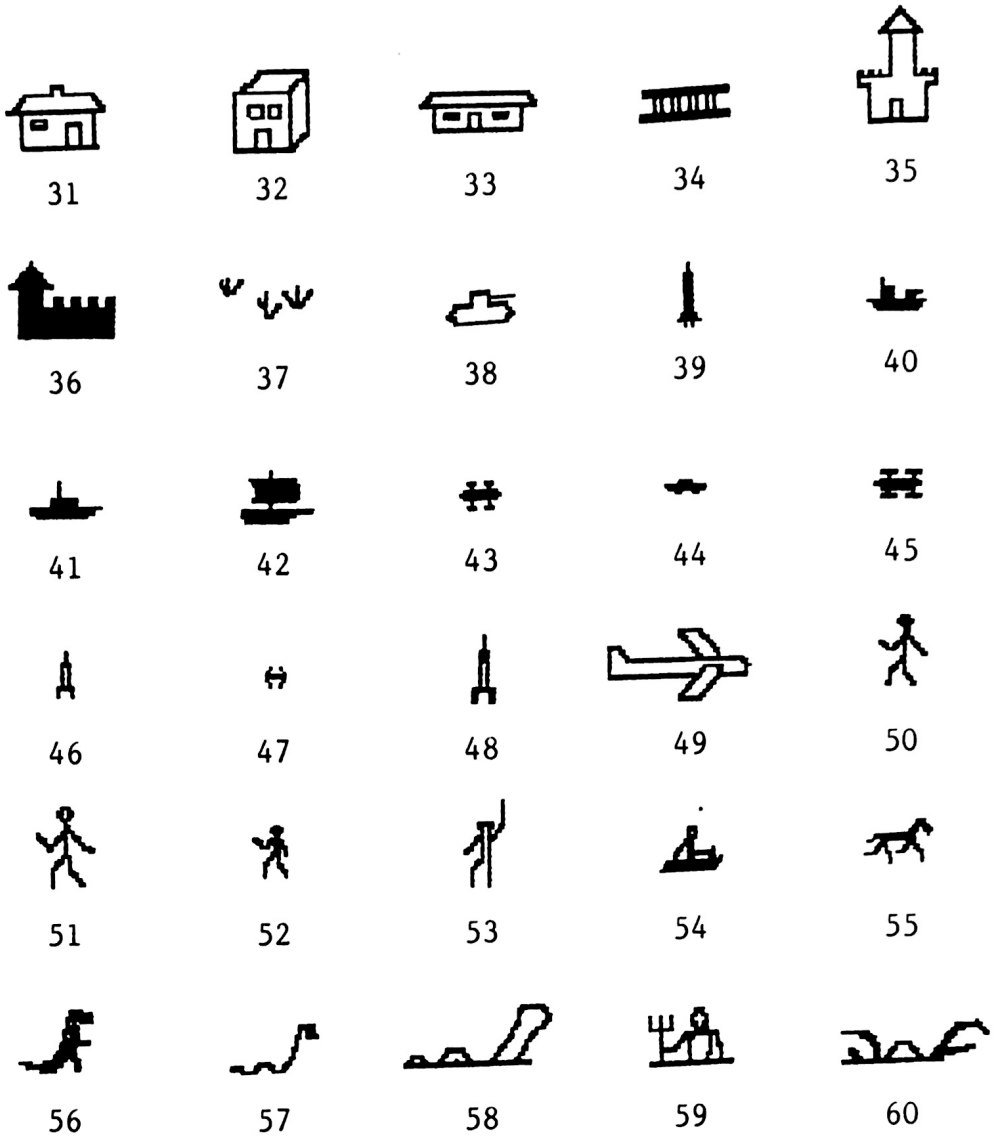
SYNTAX: &"NAME",number of shapes (always returns ´60´)
&"NAME",avar

SAMPLE: &"MISC",N

HOW TO USE IT: By using the ´command´, the shape table is automatically connected. By DRAWing the appropriate shape number you can put any of the 60 shapes on the Hi-Res screen.

Here are the shapes in MISC SHAPES.TB:





LIMITATIONS: Only those limitations (i.e. available ROT setting, etc.) that are limits of Applesoft itself. Remember that DRAW uses the current HCOLOR, whereas XDRAW is independent of current HCOLOR and merely reverses the screen background under the shape. **Remember to remove the Workbench before using this, or any of the other, Hi-Res shape commands.**

SAMPLE LISTING:

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 HGR:HCOLOR=3
20 &"MISC",NS
30 VTAB 22:INPUT"SHAPE TO DRAW?";N
40 IF N < 1 OR N > NS THEN 30
50 HGR: DRAW N AT 140,80
60 GOTO 30
```

>> SHAPE PRINTER.TB <<

by Roger Wagner

FUNCTION: This command prints a given string on the Hi-Res screen, using the current shape table.

LENGTH: 184 bytes ($B8)

SYNTAX:
```
&"NAME",sexpr [aexpr,aexpr] [;aexpr] [,aexpr]
&"NAME",string [X coord, Y coord] [;X increment]
[Y increment]
```

SAMPLE:
```
&"SPRINT",A$
&"SPRINT",A$,20,30
&"SPRINT",A$,X,Y
&"SPRINT",A$,X,Y;7,8
&"SPRINT",A$;7,8
```

HOW TO USE IT: This routine can be used to print Hi-Res text (or any series of images from a shape table) at a given position on the screen in any direction and character orientation desired. This is useful for vertical labeling of charts and pictures, along with the usual printing of Hi-Res text to the screen.

In the full form of the command, you give both a starting X and Y screen coordinate for where you want the printed string to begin, followed by a semi-colon and the X and Y increments for each successive character as it is printed on the screen. The X and Y increments determine the horizontal and vertical spacing between each letter in the final printed string. If the semi-colon and the X/Y increments are omitted from the command, default values of 7 dots per letter are used for the X increment (horizontal spacing), and a value of ´0´ is used for the Y increment (all letters will be printed on the same line).

If a value is specified for the Y increment, then the text will appear in a diagonal direction on the screen.

If the X increment is ´0´, and the Y increment is ´8´, for example, then vertical text will be printed.

Other variations possible include using negative values for the X and Y increments, (text will go in the opposite direction), and changing the SCALE and ROTATION settings (use the normal Applesoft commands for this) to achieve unusual results.

If the X and Y coordinate values are ommitted, then the printing will start at the current position of the HiRes "cursor" (i.e. the last point HPLOTed or DRAWn to).

The best way to find out the various possibilities is to just experiment with the command with different X and Y increment values and SCALE and ROTATIONs to see what happens.

The HIRES ASCII DEMO program uses the SHAPE PRINTER.TB command to draw the characters on the screen in a variety of orientations, and is a good example of what can be done with this command.

LIMITATIONS: This command does not do the equivalent of a carriage return after a print statement. That is to say, when you use the command &"SPRINT",A$ in a program line, the next Hi-Res print statement will continue on the screen at the end of the first one (it is as if any Hi-Res print command always acts like Applesoft's PRINT A$;). It is therefore up to you to correctly position each new line that will be printed on the screen. This usually means using the same X coordinate for each print command, but incrementing the Y coordinate by 8 for each successive print command. Again, see the HIRES ASCII DEMO for an example of this, as well as the sample listing below.

Remember to remove the Workbench before using this, or any of the other, Hi-Res shape commands.

SAMPLE LISTING #1: (Prints horizontally)

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 HGR:HCOLOR=3
20 &"ASC",N: X=20:Y=20
30 VTAB 22:INPUT"TEXT TO PRINT?";I$
40 &"SPRINT",I$,X,Y
70 Y = Y + 8: GOTO 30
```

SAMPLE LISTING #2: (Prints vertically)

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 HGR:HCOLOR=3
20 &"ASC",N: X=20:Y=20
30 VTAB 22:INPUT"TEXT TO PRINT?";I$
40 &"SPRINT",I$,X,Y;0,8
70 X = X + 10:  GOTO 30
```

>> SOUND EFFECTS <<

by Darrel Aldrich and David Lingwood

FUNCTION: Allows unusual sound effects in programs.

LENGTH: 28 bytes ($1C)

SYNTAX:
```
&"NAME",pitch,shape
&"NAME",aexpr,aexpr
```

SAMPLE:
```
&"SOUND",P,S
&"SOUND",10,125
&"SOUND",P+5,S/10
```

HOW TO USE IT: Both variables must be provided when using this command.

Pitch is a value in the traditional sense, with higher tones being produced by lower values. Pitch may be specified by a numeric constant, variable or expression with a value in the range from 1 to 255.

Shape is a value which will produce widely different results depending on its combination with pitch. It must also be specified with a numeric constant, variable or expression with a value in the range from 1 to 255.

You may wish to make note of combinations you find useful and/or interesting on the following page.

LIMITATIONS: Both variables must be in the range of 1 to 255. Pure tones are difficult to produce using this command. As contrasted to TONE.TB, only one pair of variables may be specified after the command name (i.e. no semi-colon option is available).

SAMPLE LISTING:

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 INPUT"PITCH,SHAPE?";P,S
20 &"SOUND",P,D
30 GOTO 10
```

DEMONSTRATION PROGRAM: SOUND EFFECTS DEMO

>> STRING INPUT.TB <<

by Craig Peterson

FUNCTION: An alternative to the usual Applesoft INPUT statement, allowing commas and colons in input strings.

LENGTH: 41 bytes ($29)

SYNTAX: &"NAME",[prompt string;] string variable
&"NAME",[string;] svar

SAMPLE: &"INPUT","ENTER A STRING";A$(I)
&"INPUT",A$

HOW TO USE IT: When inputting strings which may (or may not) contain control characters, commas, quotation marks or colons, either directly from the keyboard, or from text files on disk.

LIMITATIONS: Numeric variables may not be input using this command. ESCAPE characters/sequences will still be treated as editing sequences.

SAMPLE LISTING:

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 &"INPUT","ENTER A STRING: ";A$
20 PRINT A$
30 IF NOT (A$ = "END") THEN PRINT: GOTO 10
```

DEMO PROGRAM: STRING INPUT/TEXT OUTPUT DEMO

>> STRING SEARCH.TB <<

by Craig Peterson and Roger Wagner

FUNCTION: Finds a substring within another larger string.

LENGTH: 140 bytes ($8C)

SYNTAX: &"NAME","string to be searched","string to search for", position found at [,start position]
&"NAME",sexpr, sexpr, avar [,aexpr]

SAMPLE: &"SEARCH", "THIS IS A TEST", "THIS", P
&"SEARCH", "THIS IS A TEST", "TEST", P, N+5

HOW TO USE IT: This command is similar to the INSTR$ operator found in other BASICs. It is designed to find a given string within another string.

When using STRING SEARCH.TB the string to be searched (or its name) follows the command name. Immediately following that is the string variable, string literal or string expression for the substring which is to be searched for within the main string. After that is placed the variable in which the found position (if any) will be returned. If no occurrence is found, that variable will be set to '0'.

Additionally you may place another variable at the end of the command to specify the character position to begin the search at. If this variable is omitted, then a starting position of '1' is assumed.

LIMITATIONS: The starting character position, if used, must have a value in the range of 1-255. String data (NOT NUMERIC) must be used for both main string and search string variables.

SAMPLE LISTING:

```
  1 CALL PEEK(175) + 256 * PEEK(176) - 46
 10 INPUT"STRING TO SEARCH:";I$
 20 INPUT"STRING TO SEARCH FOR?";S$: N = 1
 30 &"SEARCH",I$,S$,P
 40 IF P=0 THEN PRINT"NOT FOUND":END
 50 PRINT"FOUND AT POSITION ";P
 60 N = P + 1: GOTO 30
```

DEMONSTRATION PROGRAM: STRING SEARCH DEMO

>> SWAP.TB <<

by Craig Peterson

FUNCTION: Swaps two Applesoft variables without requiring a third variable, and more importantly, without generating "garbage" which would have to be handled later.

LENGTH: 58 bytes ($3A)

SYNTAX: &"NAME",avar,avar or... &"NAME",svar,svar

SAMPLE: &"SWAP",A$,B$ or... &"SWAP",X,Y

HOW TO USE IT: This is most often used in sort routines and in general whenever you want to set one variable equal to another without generating additional "dead strings" in memory. If either variable does not exist, one will be created under that name, and given a null value. Thus, after the swap, the "new" variable will hold the old variable's data, and the "old" variable will be null.

LIMITATIONS: You cannot use variable expressions such as:

&"SWAP",A$,MID$(B$,1,1)

Both variable types must match; you could not use:

&"SWAP",A,A%

SAMPLE LISTING:

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 INPUT"STRING1, STRING2?";A$,B$
20 PRINT A$,B$
30 &"SWAP",A$,B$
40 PRINT A$,B$: REM NOW SWAPPED
```

DEMONSTRATION PROGRAM: SWAP DEMO

>> TEXT OUTPUT.TB <<

by Steve Cochard

FUNCTION: Prints text to screen or printer without word breaks at right margin.

LENGTH: 335 bytes ($14F)

SYNTAX: &"NAME",sexpr [,aexpr] [,aexpr] [AT aexpr] [;]
&"NAME",string [,width] [,indent] [AT spacing] [;]

SAMPLE:
```
&"TEXT","THIS IS A TEST"
&"TEXT",A$;
&"TEXT",B$ AT 2
&"TEXT",A$,75,5 AT 3;
&"TEXT",A$+B$,80 AT 2
```

HOW TO USE IT: This routine is similar to the Applesoft PRINT statement, except that it is designed to eliminate the splitting of words at the ends of lines.

As in the standard PRINT statement, the presence of a semicolon at the end signifies that no carriage return is to be printed after the final character.

If the width variable is not specified then it is assumed to be the current screen width. Thus you can omit this variable when outputting to the screen with the text window set normally or using the WINDOW.TB command. When sending text to a printer, the width should be set to the maximum number of columns supported (usually 80).

When text is being displayed on the screen, you may indent the first word (as at the start of a paragraph) by using the HTAB command to position the cursor appropriately before calling the routine. When printing multiple sentences, it is recommended that you define each string with two spaces following the period at the end. This will then properly format entire paragraphs to the screen.

Each variable in the variable list after the string to be printed is optional. This means you can omit any of the values you wish and the current screen values / print defaults will be used.

The defaults are:

column width: Uses current text screen right window boundary. Automatically adjusts for an indent value or left window setting if needed.

indentation: Uses current text screen left window boundary.

spacing: Uses a value of ´1´ (i.e. normal single spacing).

If the semi-colon (";") is not used, a carriage return will be printed at the end of the output string.

Using the WINDOW.TB command is the preferred way of determining the left are right boundaries for your text. The use of specific variables is allowed to make this command usable for printer output.

LIMITATIONS: The text printed must be a string; numeric data is not allowed. You may however use Applesoft´s STR$() function to convert any number to a string.

The width variable must be not be less than the length of the longest word in the text. Values less than ´20´ are dangerous in this regard. If you are specifying the allowable width yourself, remember that on a 40 column screen, an indentation value of ´5´ leaves a maximum width of 35 characters.

SAMPLE LISTING:

```
  1  CALL PEEK(175) + PEEK(176) * 256 - 46
 10  HOME
 20  A$(1) = "ONCE UPON A TIME THERE WAS A DARK AND DEEP
     FOREST, FILLED WITH MYSTERIOUS PRESENCES, "
 30  A$(2) = "LIKE ELVES, TROLLS, PIXIES, GIANTS AND
     ORCS.  "
 40  A$(3) = "ONE DAY BO-PEEP CAME ALONG, LOOKING FOR
     HER SHEEP ... "
 40  J = 1
 50  HTAB J
 60  FOR I = 1 TO 3
 70  & "TEXT", A$(I);
 80  NEXT: PRINT: PRINT
 90  J = J+5:IF J < 30 THEN 50
```

DEMONSTRATION PROGRAM: STRING INPUT/TEXT OUTPUT DEMO

>> TONE.TB <<

by Craig Peterson

FUNCTION: Generates a pure tone of a given pitch and duration. Can also be used to pause.

LENGTH: 76 bytes ($4C)

SYNTAX: &"NAME" [,aexpr [, aexpr]] [;aexpr [, aexpr]]
&"NAME" [,pitch [, duration]]

SAMPLE:
```
&"TONE"
&"TONE",P
&"TONE",P,D
&"TONE",P+5,D/2;P2,D2;P3,D3;P4;P5;P6
```

HOW TO USE IT: The TONE.TB command can be used in a variety of ways. If no variables are included after the name, then a tone having about the same pitch and duration of the normal Apple beep will be sounded.

If one variable is included after the command name, it will change the pitch of the tone. This variable can be any numeric constant, variable or expression, but must have a value from 0 to 255. Lower values cause higher pitches. A value of ´0´ produces no sound. If the pitch value is doubled, then a tone about one octave lower will be produced.

If a second variable is given, the length of the tone can be changed. The length variable can also be any numeric constant, variable or expression having a value between 0 and 255. This length value is determined in approximately 1/100´s of a second, so ´100´ would produce a tone of about one second in length. This allows tones with lengths ranging from 1/100 to over 2.5 seconds in length.

With pitch set to ´0´, the duration can be adjusted to produce silent waits of 1/100 to 2.5 seconds.

In addition, multiple tone variables can be included in a single command statement by using a semi-colon to separate each new TONE command. Variables following each semi-colon can either be a pair to specify both pitch and duration, or just a single pitch variable.

Be sure to run the TONE DEMO to see what the musical possibilities of this command are.

LIMITATIONS: Both pitch and duration values must be numeric variables in the range of 0-255.

SAMPLE LISTING:

```
 1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 INPUT "PITCH, DURATION?";P,D
20 &"TONE",P,D
30 GOTO 10
```

Here is a table of the note values produced with different values for pitch:

NOTE	PITCH NO.	PITCH NO.	PITCH NO.
F SHARP	135	67	33
F	143	71	35
E	151	75	37
E FLAT	160	80	40
D	170	85	42
C SHARP	180	90	45
C	191	95	47
B	202	101	50
B FLAT	214	107	53
A	227	113	56
A FLAT	241	120	60
G	255	127	63

AND.. 31 (G)

DEMONSTRATON PROGRAM: TONE DEMO

>> TURTLE GRAPHICS.TB / TURTLE GRAPHICS+.TB <<

by Michael Freeman

FUNCTION: Provides a set of Hi-Res graphics drawing commands based on the concept of "turtle graphics".

LENGTH: 612 bytes ($264) basic version
988 bytes ($3DC) "+" version

SYNTAX: &"NAME",command character [,variable(s)]
&"NAME",character [,aexpr(s)]

The following provides information on each of the various commands available in TURTLE GRAPHICS.TB and TURTLE GRAPHICS+.TB.

GENERAL INFORMATION:

Turtle Graphics is based on the concept of an imaginary "turtle" which can be directed in various motions across the screen. Attached to our critter's tail is an equally imaginary pen. If the pen is "down" while he moves, a trail is left behind tracing his path. If the pen is "up", no trail is left and the turtle simply moves to a new position.

Drawing is usually initiated by starting the turtle out at a given position on the screen, facing a given direction, with the pen down. From there the turtle is directed to either "move" or "turn". Moves are given by a number of screen units, turns are specified in degrees. Turns can either be relative to the current direction, or an absolute angle, with zero degrees being defined as the turtle facing the right edge of the screen.

The advantages of Turtle Graphics over X,Y coordinate graphics are best utilized when doing shape related graphics. Whether to use Turtle Graphics or the usual HPLOT X,Y method is best judged by the individual programmer according to the application.

SPECIFIC COMMANDS:

Note that all commands begin with a command function letter, followed by a variable list (except for 'INIT'). Where a value is specified by 'aexpr', this signifies the use of a numeric constant, variable or expression.

```
INIT     &"TG",I
```

Places the turtle at 140,96 in direction zero degrees (facing right) with the pen "down". This command MUST be given **before** any of the other Turtle Graphics commands.

```
SET      &"TG",S,horiz,vert,angle
         &"TG",S,aexpr,aexpr,aexpr
         &"TG",S,X,Y,D
```

Places the turtle at X,Y in direction D (degrees).

```
PEN      &"TG",P,pen status
         &"TG",P,aexpr
         &"TG",P,P
```

If aexpr is non-zero, then the pen is "down" (plots).
If aexpr is zero, the pen is "up" (does not plot).

```
TURN     &"TG",T,relative angle
         &"TG",T,aexpr
         &"TG",T,A
```

Turns the turtle relative to its current direction. Positive values correspond to a clockwise turn, negative to counterclockwise.

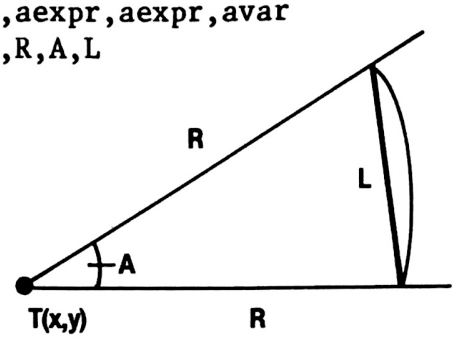
```
         &"TG",T,@A
         &"TG",T,@absolute angle
         &"TG",T,@aexpr
```

Turns the turtle to face an absolute angle (in degrees) given by aexpr.

```
MOVE     &"TG",M,distance
         &"TG",M,aexpr
         &"TG",M,S
```

Moves the turtle in its current direction 'S' units. If the pen is down, a trace in the current HCOLOR will be left. If the pen is up, no trace will be left.

CHORD &"TG",C,radius,angle,length
&"TG",C,aexpr,aexpr,avar
&"TG",C,R,A,L



Given the radius ´R´ And the angle in degrees ´A´, this returns in the variable ´L´ the length of the chord.

FIND &"TG",F,horiz,vert,direction [,pen status]
&"TG",F,avar,avar,avar, [,avar]
&"TG",F,X,Y,D [,P]

Returns the current turtle position in terms of the X and Y coordinates, and the direction the turtle is facing (in degrees). An optional fourth variable may be included, into which will be placed a 1 or a 0 depending on the status of the pen. ´1´ signifies pen "down", ´0´ corresponds to pen "up". This has no effect on the current position or status of the turtle.

ARC &"TG",A,radius,angle
&"TG",A,aexpr,aexpr
&"TG",A,R,A

Draws an arc of radius ´R´ for an angle of ´A´ degrees. Arc is started in direction the turtle is facing and proceeds clockwise for positive values of ´R´ (Radius), and counter clockwise for negative Radius values. Note that this option is available on the ´+´ version only.

LIMITATIONS: Although normal Hi-Res graphics may be used in conjunction with the turtle commands, be aware that there is some interaction. Whenever the turtle is moved, the internal Hi-Res "cursor" is updated. Thus, the following commands:

&"TG",S,140,96,0: HPLOT TO 0,0

would draw a line from the center of the screen to the upper left-hand corner. Using this feature, any HPLOT TO command may use the current turtle position as a starting point. However, the converse is not true. You

may not do a HPLOT to a position and then expect the turtle to go from there.

To summarize: Turtle move commands DO affect subsequent HPLOT commands. HPLOT commands DO NOT affect the turtle.

If an attempt is made to draw off the screen, an ILLEGAL QUANTITY error will be generated. Use SET or INIT to reposition the turtle back onto the screen. Any attempt to MOVE back may produce unpredictable results.

Values for X and Y coordinates must be within the normal permissable range for Applesoft Hi-Res graphics. (X in the range 0 to 279, Y in the range 0 to 159 (mixed screen) or 191 (full screen)).

Angle measurements may be greater than + or - 360 degrees, but will wrap-around. That is to say that specifying an angle of 370 degrees will have exactly the same result as specifying an angle of 10 degrees.

Two different versions of TURTLE GRAPHICS are included on the Wizard's Toolbox diskette. Although the 'plus' version offers the additional command 'ARC', it is somewhat longer. If memory is a problem, and you do not need the ARC function, then simply use the smaller version of the package, TURTLE GRAPHICS.TB.

Remember to remove the Workbench before using this, or any of the other, Hi-Res shape commands.

SAMPLE LISTINGS:

#1: BOX

```
 1 CALL PEEK(175) + 256 * PEEK(176)-46
10 HGR: HCOLOR = 3
20 &"TG",I
30 FOR I = 1 TO 4
40 &"TG",M,50: &"TG",T,90
50 NEXT I
```

#2: POLYGONS

```
 1 CALL PEEK(175) + 256 * PEEK(176)-46
10 HGR: HCOLOR = 3
20 &"TG",I
30 FOR S = 3 TO 15
40 A = 360/S: &"TG",S,140,10,0
50 FOR J = 1 TO S
60 &"TG",M,30: &"TG",T,A
70 NEXT J
80 NEXT S
```

#3: DESIGN

```
 1 CALL PEEK(175) + 256 * PEEK(176)-46
10 HGR: HCOLOR = 3
20 &"TG",I
30 FOR D = 0 TO 360-10 STEP 10
40 &"TG",S,140,96,D
50 &"TG",M,60: &"TG",T,90: &"TG",M,60
60 &"TG",T,90: &"TG",M,60
70 NEXT D
```

#4: RAINBOW

```
 1 CALL PEEK(175) + 256 * PEEK(176)-46
10 HGR
20 &"TG",I
30 FOR R = 20 TO 70
40 HCOLOR = INT(R/10)-(R<50)
50 &"TG",S,140-R,100,-90
60 &"TG",A,R,180
70 NEXT R
```

DEMONSTRATON PROGRAM: TURTLE GRAPHICS DEMO

>> XNUM.TB <<

by Roger Wagner and Craig Peterson

FUNCTION: This will convert numbers between decimal and hexadecimal notations.

LENGTH: 242 bytes ($F2)

SYNTAX:
```
&"NAME",hex string variable,decimal real
        variable
&"NAME",decimal real variable,hex string var.
&"NAME",sexpr|aexpr, avar|svar
```

SAMPLE:
```
&"XNUM","$200",N (N will come back = 512)
&"XNUM",512,H$   (H$ will come back = $0200)
&"XNUM",H$,N
&"XNUM",N,H$
```

HOW TO USE IT: How you use XNUM.TB will depend on whether you are converting decimal to hexadecimal, or vice versa.

To convert decimal to hex, simply follow the command name with any numeric constant, variable, or expression. Then follow that with the string variable into which you wish the hex equivalent string placed. The result will then be placed in that string, at which point it may be printed, or passed to another command.

To convert hex to decimal, follow the command name with a string variable or expression containing the hex number to be converted. The string must begin with a dollar sign ($) and be one to four digits long (not including the dollar sign). Then follow that with a real or integer variable into which the decimal equivalent will be placed. After the call, the variable will be equal to the decimal value for the hex string specified. If a real variable is used, then results can be in the range of 0 to 65535. If an integer variable is used, then results greater than 32767 will be expressed in the negative form.

LIMITATIONS: The hex string must be a string variable, whose contents are a legitimate hex number, beginning with a dollar sign. Numbers from $0000 to $FFFF can be converted. When converting decimal to hex, the decimal value must be in the range of -65535 to 65535.

SAMPLE LISTING:

```
  1 CALL PEEK(175) + 256 * PEEK(176) - 46
 10 INPUT"NUMBER TO CONVERT?";N$
 20 IF LEFT$(N$,1) = "$" THEN 100
 30 N = VAL(N$)
 40 &"XNUM",N,H$
 50 PRINT N;" = ";H$
 60 END

100 &"XNUM",N$,N
120 PRINT N$;" = ";N
130 END
```

DEMONSTRATION PROGRAM: JUMP FILE CREATE

>> TOOLBOX WORKBENCH MAIN MENU <<

The following pages contain further details on each of the menu choices presented when running the Workbench utility program. They are provided to answer any specific questions which might arise about a given menu choice.

MENU OPTION PREREQUISITES

For each of the options listed in the menu, certain conditions must be satisfied before the option can be selected. The prerequisites for each of the options are stated below:

1	ADD A COMMAND	There must be a program in memory.
2	REMOVE A COMMAND	At least one command must be added.
3	REMOVE ALL COMMANDS	At least one command must be added.
4	COPY ALL ADDED COMMANDS TO DISK	There must be added commands present.
5	RESTORE COMMANDS FROM DISK	This option can be exercised ONLY if no commands are present.
6	REPORT COMMANDS ADDED	At least one command must be present.
7	SEARCH FOR COMMANDS	There must be a program in memory.
8	DISPLAY MEMORY MAP	There are no prerequisites.
0	EXIT	There are no prerequisites.

OPTION #1: ADDING COMMANDS

Although most of the important points regarding this operation have already been covered in the beginning of this manual, one more comment is in order regarding this option.

When making up your name for an added command, the name used to call the command can be anything you like, subject to the following restrictions:

a) The maximum length of the command name is fifteen characters.

b) Control characters are not permitted; otherwise all keyboard characters other than ´]´ and quote marks (") are permitted.

c) The first character must not be a space; otherwise spaces within the name are permitted.

The name used for a command is also independent of the name of the Toolbox File used to add the command.

If you should forget the name you gave a particular command, you can always use Option #6 (Command Report) to get a report on the command names (and the original file names) of all currently added commands.

OPTION 2: REMOVE A COMMAND

Suppose you have added 23 commands and then decide you really don´t want command #5. The Workbench allows you to remove it easily. Select ´2´ at the menu, and the first page of a command report will appear. This chart will show all of the added commands, giving both the command name, and the name of the Toolbox File from which the command was derived.

The commands are shown eight at a time. If you want to go to the next eight, simply press the space bar to advance. You can also return to the main menu at any point by pressing RETURN alone.

If you see the command you wish to remove, press the ´R´ key to tell the program you wish to remove an item. Then enter the number of the command you wish to remove.

The Workbench will then remove the specified command and return you to the main menu.

OPTION 3: REMOVE ALL COMMANDS

It is also possible to remove all added commands at one time. Select option #3 for this function. You will be asked to confirm your intentions for such a drastic action. You must respond with either 'Y' or 'N' to this question.

SPECIAL NOTE: If you use Apple's Renumber program, or use use Hi-Res graphics with a program that is too long, you may destroy some of the added Toolbox commands. If this happens, item #3 in the main menu will change to 'REMOVE APPENDED MACHINE CODE', meaning that the Workbench can no longer recognize the added Toolbox commands. See the MEMORY MAP section later and Appendix A (A Little More Detail) for more information about this situation.

OPTION #4: COPYING ALL COMMANDS TO DISK

After using The Workbench for a while, you will probably find that there is a certain group of commands which you almost always put in your programs. Option 4 may be used for saving an assembled group of commands to disk as a single file. This enables you to add the entire group of commands at one time (using Option 5) to an Applesoft program in the course of development.

Such a mini-library can really come in handy when you write a variety of different programs. An example of a group of commands which could make up a good mini-library include:

a) AMPERSAND RESTORE.TB
b) RESET ONERR.TB
c) STRING INPUT.TB
d) ERR.TB

To save a mini-library to disk, select item #4 in the main menu of the Workbench.

The screen will then display:

```
ALL ADDED COMMANDS WILL NOW BE
COPIED TO A FILE ON DISK

DO YOU WISH TO USE 'CMD FILE'
AS THE FILE NAME?  [Y]
```

If you press 'Y' (or just RETURN) here, the Workbench will save a copy of all the added commands to the diskette under the name 'CMD FILE'.

If you want to give the file a different name, just press 'N' and enter the name of your choice. This is the recommended method, so that you don't accidentally overwrite another previously saved mini-library.

The main purpose for the 'CMD FILE' name option is for temporary saving of a group of commands. This is useful when using the second main application of this option, which is to save added commands to disk to enable the performance of some operation which might damage appended machine code, i.e. added Toolbox commands.

Although none of Roger Wagner Publishing's software will damage added commands, the same cannot be said for all utilities. In particular, APPLE COMPUTER'S RENUMBER program WIPES OUT all commands (or machine code) added to an Applesoft program.

It is not difficult to use Apple Computer's Renumber program to renumber an Applesoft program which has Toolbox Files added, but to do so you must first use Option #6 to copy all added commands to disk.

Then use Option #3 to remove all added commands. You may now renumber your program (or use whatever other utility you wish here). Finally, use Option #5 to restore the commands that you saved to disk with Option #6. This procedure is not required for any utility that does not destroy appended machine language at the end of an Applesoft program.

OPTION #5: RESTORING ADDED COMMANDS FROM DISK

If you have used option #3 to remove added commands your program, or if you are just starting a new program, to which you wish to add a pre-assembled mini-library, you may use Option #5 (RESTORE ADDED COMMANDS FROM DISK) by following the procedures listed here:

1) If the Workbench is in memory, re-enter with a CALL 2051. If the Workbench is not in memory, enter BRUN WORKBENCH.

2) When the menu appears, select Option #5 by pressing '5'. You will be asked to confirm by pressing 'Y' (for Yes) or RETURN alone.

3) The program will then display:

IS THE COMMAND FILE TO BE RESTORED
CONTAINED IN DISK FILE ´CMD FILE´? [Y]

If you have not used this file name to save the added commands, enter ´N´ (for NO). It will then display:

WHICH FILE NAME THEN? (<RET> = QUIT)
(FOR CATALOG ENTER ´CAT´)

You may now either catalog the disk or enter the name under which the commands were saved.

4) The Toolbox will now restore the commands which were formerly copied to disk, and return you to the menu.

If the added commands were originally copied to a disk file under the name ´CMD FILE´, then the Workbench will delete this file from the disk. If you specified some other name for the disk file, then it will not be deleted.

OPTION #6: REPORT COMMANDS ADDED

The Workbench may be used to add up to 255 commands to an Applesoft program. Although it is unlikely you will even approach this number, you may from time to time wish to see a list of the commands which have been added to a particular Applesoft program.

Pressing ´6´ at the main menu will produce a Command Report. This is useful because it allows you to see what commands have already been added and to check on the names given to them.

When selecting each of the ´report´ options 6 - 8, you are asked if output is to go to the printer. If you simply want screen display, press RETURN (or ´N´). If you want a print-out, press ´Y´. The Workbench will then ask:

PRINTER IN SLOT: 1

If this is the correct slot for your printer, press RETURN, otherwise enter the slot your printer is in.

For each command added you are informed of the command name and the name of its disk file.

The Command Report displays eight commands at a time. If you have more than eight commands added then press the space bar to go to each successive page (or you can return to the menu at any point by pressing RETURN).

It is also possible to transfer directly from the Command Report to the Search option by entering 'S'.

OPTION #7: SEARCHING FOR TOOLBOX COMMANDS

This option is provided so that you can list every line in your program that uses a Toolbox command. This is especially useful when combined with the Command Report option.

The search function has three options: (1) all statements in your program using an ampersand (or CALL), (2) all Toolbox commands, or (3) use of only a particular command.

To see how the SEARCH option works, follow these examples:

1) From the Workbench, select Option #0 to exit the program. Then type in 'NEW' to clear memory.

2) Now enter LOAD BINARY FILE COPIER (on the back of the Wizard's Toolbox disk).

3) When the Applesoft prompt returns, enter CALL 2051 to re-enter the Workbench.

4) At the menu, select Option #7 and press RETURN. The Workbench will then display the following:

```
SEARCH TYPE:   AMPERSAND STATEMENTS

DO YOU WISH TO SEARCH FOR:

1  ALL SUCH STATEMENTS?
2  ALL TOOLBOX COMMANDS?
3  A PARTICULAR COMMAND?

(PRESS 'T' TO CHANGE SEARCH TYPE,
OR <RETURN> TO QUIT)
```

5) Select Option #1 to display all of the ampersand statements. Since BINARY FILE COPIER contains a considerable number of ampersand statements it will be necessary to press the space bar once or twice to display them all (remember only eight are displayed at a time). Notice that on each page the Workbench displays:

PRESS 'S' FOR NEW SEARCH
OR <SPACE> TO CONTINUE

at the bottom of the screen to prompt you for the next page of ampersand statements, as well as to provide you the option of changing the search to CALLS instead of AMPERSANDS.

Since the ampersand is used in the program only to call Toolbox commands, and this is the only method used to call the commands, you will see the same display whether you select option 1 or option 2.

Normally commands will use the ampersand, but there is an alternative method which employs a CALL directly to the Toolbox commands themselves. (See Appendix B for details.) Thus when searching for the Toolbox commands in your program you may specify that the search is to be for ampersands or for CALLs. (The latter option also allows you to search for all CALLs in an Applesoft program whether or not they are Toolbox commands.) You can toggle between these two options by pressing 'T'.

To see how this works, continue as described here:

6) Press 'S' to return to the search menu, and press 'T' to change to the search for CALLS and repeat the steps to display the CALLS used in the program. Notice the top line of the search menu now appears as:

SEARCH TYPE: CALL STATEMENTS

When an ampersand or CALL statement is found which satisfies the conditions of the search, it is displayed along with the number of the line in which it occurs.

If the line consists of more than one statement, as in the statement below:

```
N = INT(VAL(LEFT$(B$(J),4))): &"TONE": FOR I=1 TO N:
PRINT A$(I);: PRINT " = "A(X(I)): PRINT: NEXT
```

then only the command statement itself will be displayed, as in:

&"TONE"

SPECIAL NOTES:

If you are using the CALL method of using Toolbox commands, a typical command statement would be:

CALL IR "NAME", A$, B$

You might erroneously omit the 'IR' so that your program would contain the statement:

CALL "NAME", A$, B$

This would make a nice method of using a command, except that it doesn't work! "NAME" (a string literal) cannot be evaluated as a calling address.

If you use the SEARCH OPTION, and the Workbench finds a CALL statement with some expression following the CALL which cannot be evaluated as an address, it will display the offending statement along with an error message, and return you to the immediate mode of Applesoft. This gives you the opportunity to correct the CALL (by replacing, e.g., CALL "NAME" with CALL IR "NAME"). You can then re-enter the Workbench with the usual CALL 2051 and resume normal operations.

OPTION #8: THE MEMORY MAP

The use of this option is not required for adding or removing commands, but does provide useful information such as the number of bytes that the added Toolbox commands are adding to an Applesoft program. In addition, use of this function is highly recommended if you are using Hi-Res graphics.

The Memory Map is selected by choosing Option #8 from the main menu of the Workbench. As with previous 'report' options, you may output the Memory Map to the printer by entering a 'Y' when the Workbench asks you about printer output.

As noted before, the Workbench occupies memory from $800 to $25FF, and when it is present your Applesoft program starts at $2601 instead of the usual location of $801 (see the diagrams on pp.84-85 of this manual).

Normally you will be more interested in the location of your program at run time, rather than its location when the Workbench is present.

Thus when the Memory Map is first displayed it shows the location of your program AS IF it were at $801. If you then press 'A' the Memory Map will change to display the current actual addresses (with your program at $2601). You can toggle back and forth between these two modes using the 'A' key.

The Memory Map does not always have the same format. It differs according to whether there is a program in memory and whether it has any added commands.

When there is no program in memory, the Memory Map displays only four addresses, such as the following:

```
PROGRAM START:          $0801 =  2049
LOMEM:                  $0804 =  2052
HIMEM:                  $9600 = 38400
DOS BUFFERS:            $9600 = 38400
```

Considerably more information is displayed when there is a program in memory. The following is a typical Memory Map, corresponding to a situation like that shown in Figure 3 on page 85 of this manual.

```
                APPLE ][ MEMORY MAP

PROGRAM START:                  $0801 =  2049
BASIC PROGRAM END:              $0F5F =  3935
ACTUAL PROGRAM END:             $1289 =  4745
LOMEM = SIMPLE VARIABLES:       $1289 =  4745
ARRAY SPACE:                    $12BA =  4794
ARRAY SPACE ENDS:               $12E2 =  4834

STRINGS:                        $936E = 37742
HIMEM = END STRINGS:            $9600 = 38400
DOS BUFFERS:                    $9600 = 38400

BASIC PROGRAM LENGTH:           $075E =  1886
TOOLBOX BYTES ADDED:            $032A =   810
TOTAL PROGRAM LENGTH:           $0A88 =  2696
FREE SPACE:                     $808C = 32908
STRING STORAGE:                 $0292 =   458
NOTHING UNDER DOS BUFFERS

MAXFILES = 3
```

The most interesting thing to notice in this chart is the entry "TOOLBOX BYTES ADDED" compared to the entry "BASIC PROGRAM LENGTH". In the above example, the program is 1886 bytes long, while there are 810 bytes of machine code appended in the way of Toolbox commands. This means that this program is approximately 30% machine code. This percentage is often even greater as you use more and more Toolbox commands.

The net result is that you'll find that even though it appears you are writing a program in BASIC, it is not unusual to find that over 50% of the final program is written in fast and compact machine code!

HI-RES GRAPHICS AND THE MEMORY MAP

The most important function of the memory map is if you are using Hi-Res graphics in your program. Because the Hi-Res page occupies the middle memory range of your computer, an Applesoft program can become so long as run into the area used for graphics. The symptoms of this are program crashes after an HGR or HGR2, or strangely changing variable values while using graphics.

The memory map can be used to predict when a problem is likely to occur.

1. If the ACTUAL PROGRAM END value is greater than $2000 ($4000 if you are using HGR2), then your program is too long.

Solution: Remove REMark statements from your program and take other steps to shorten the length of the listing, such as combining lines where possible. You can also use utilities such as Roger Wagner Publishing's APPLE-DOC II to compress your BASIC program, or use the Chart 'n Graph Toolbox to move your program above the Hi-Res page.

You can also add the following line to your program:

```
2   IF PEEK(104)=8 THEN POKE 104,64:POKE 16384,0:PRINT
CHR$(4);"RUN MYPROGRAM": REM FOR HGR USE
```

or:

```
2   IF PEEK(104)=8 THEN POKE 104,96:POKE 24576,0:PRINT
CHR$(4);"RUN MYPROGRAM": REM FOR HGR2 USE
```

where 'MYPROGRAM' is the name of your program as stored on the diskette.

If your program does not exceed $2000 (or $4000 for HGR2), then you should also remember to always use a LOMEM: 16384 (24576 for HGR2) as line 2 of your program.

If you are unfamiliar with the other memory locations mentioned in the memory map, we recommend "ALL ABOUT APPLESOFT", available from local computer stores and also from Roger Wagner Publishing.

APPENDIX A

A LITTLE MORE DETAIL

The information in this section gets a bit technical. It is included here for the enjoyment of the programmer that wants to know more about how the Toolbox actually operates.

Although it is not necessary to understand all the information provided here to use Toolbox system, it may help you get a better feeling for what you are actually doing when you use it. It is also a required background for the information that follows in the next sections on writing your own Toolbox files.

In addition, there is a description of the conflict between a long Applesoft program and the Hi-Res pages, which may be helpful if you are using graphics.

When you first specify the name of a command to be put in your Applesoft program, the Workbench does the following things:

1) It appends the Toolbox File to the end of your Applesoft program. Because of the nature of Applesoft, this machine code is not visible during a LIST, and is unaffected by adding or deleted normal BASIC lines or statements.

2) It saves both the name you give to use the routine, and the name of the disk file loaded. This is to make later identification of commands easier (see the section on the Command Report).

3) The first time a command is added, the Workbench adds its own ´Interface Routine´ to the end of your program. The function of this is to locate a routine named in a Toolbox command and to pass control to it.

The manner in which memory is normally allocated in the Apple computer is as follows:

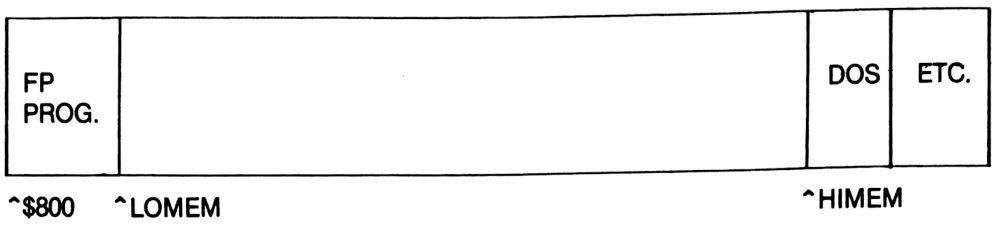


Figure 1: "Normal" Applesoft program

Normally an Applesoft program resides at the "bottom" of memory, with all remaining space above it reserved by DOS and for variable storage.

The Workbench could be loaded right after your program, but as Toolbox Files were added to the end of the Applesoft program, they would start to conflict with Workbench itself. To avoid this, the Workbench moves your program UP in memory, and locates itself at memory location $800 (the dollar sign indicates a hexadecimal address).

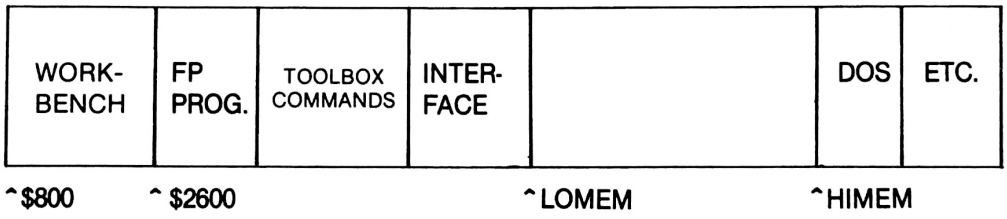


Figure 2: With the Workbench installed

With your program safely relocated to $2600, routines are automatically placed between the Interface Routine and the end of your program ('FP PROG' on the chart). When your program is run, the Line #1 that was put in by the AMPERSAND SETUP file points the ampersand vector to the Interface Routine at the end of your program. From there the name following the ampersand is read and the proper routine used.

CAUTION: Note that your program now STARTS at $2600. This is well into the Hi-Res page 1 display, which normally starts at $2000. Thus, any program using an HGR command will destroy itself if you attempt to run it with

the WORKBENCH itself in memory. The Workbench should be removed before running any program using Hi-Res graphics.

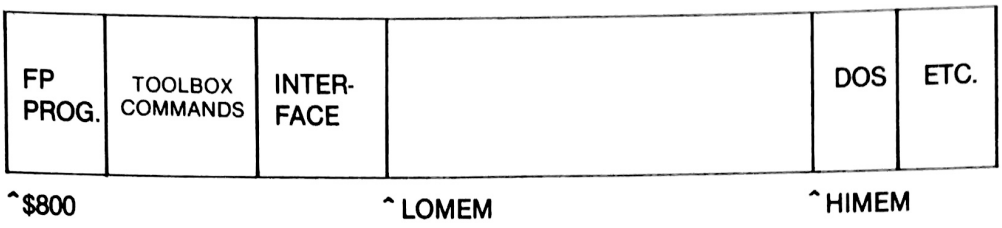


Figure 3: At 'Run Time'

If you use the REMOVE WORKBENCH utility, or do a fresh load of an Applesoft program containing appended Toolbox files after entering ´FP´, then memory will be allocated as in Figure 3. This shows the Applesoft program back at its normal location, with the appended routines and the Interface Routine still present.

Hi-Res graphics on page 1 will in most cases now be available. When in doubt, you can use the Memory Map option from the Workbench (see p.78 of this manual) showing the addresses for your program at its normal location of $801.

When developing a program using Toolbox commands, you can proceed in three ways:

1) Add commands to your program, one at a time, as required.

2) Work on the BASIC portion of your program first, and then add the required commands later, or

3) Add all required commands and then write the BASIC portion of the program which calls them.

HI-RES GRAPHICS, RENUMBERING AND OTHER HAZARDS TO THE TOOLBOX

Improper use of Hi-Res graphics, or use of Apple´s Renumber program can destroy added Toolbox commands in your Applesoft programs.

If you are using Hi-Res graphics with the Toolbox system, you should be sure to read the section on the Workbench´s MEMORY MAP option. This will help you avoid

having an HGR or HGR2 command destroy added Toolbox commands.

If you are using Apple's Renumber program, be sure to read the section in this manual on COPYING ALL COMMANDS TO DISK in the Workbench. (is this there?)

If the worst should happen and your added Toolbox commands are damaged, you will be able to tell because the Workbench main menu will say NO COMMANDS ADDED, and option #3 will now say REMOVE APPENDED MACHINE CODE.

This is because the Workbench can tell that you have something (destroyed Toolbox commands probably) still added to your program, but it doesn't recognize it as the Toolbox commands.

This can be verified by going to the MEMORY MAP, where the screen will now display BYTES APPENDED where it used to read TOOLBOX BYTES ADDED. Again, the Workbench is telling you that something is left hanging on the end of your program, but it doesn't know what.

If this should happen, you will have to use option #3 to remove the damaged Toolbox commands, and then individually re-add the various Toolbox commands used by your program. Option #7 may be helpful here as it can be used to list all the Toolbox commands called by your program.

APPENDIX B

ALTERNATIVE METHODS OF USING A COMMAND

Please note that this section is not required to make use of the Toolbox system. This section explains a method of using Toolbox commands which does not make use of the ampersand.

Before describing that method, however, following is a brief discussion of how an Applesoft program is structured in memory. If you have not already familiar with the subject, this may be of some interest, and help in understanding the other topics mentioned in this Appendix.

THE INTERNAL STRUCTURE OF APPLESOFT

When an Applesoft program is present in memory there are two 'pointers' which point to the beginning and to the end of the program. These are stored on Page Zero ($0000-$00FF) in the usual 6502 convention (low byte followed by high byte) as follows:

POINTER	HEX ADDRESS	DECIMAL ADDRESS	DESCRIPTION
TXTTAB	$67,68	103,104	Start of Program
PRGEND	$AF,B0	175,176	End of Program

The start of the program could thus be determined from BASIC by the statement:

```
BEG = PEEK(103) + 256 * PEEK(104)
```

and the end by:

```
END = PEEK(175) + 256 * PEEK(176)
```

(NOTE: PTR READ.TB and PTR WRITE.TB are Toolbox commands which make such determinations quite simple. See the section on those commands for more details.)

To understand better how Applesoft actually stores a program in memory, type 'FP' and enter the following program:

```
 5  A = 1: B = 2
10  C = 3
```

Now go into the Monitor with a CALL -151. Type 67.68 and press RETURN. The computer should print out:

```
0067- 01
0068- 08
```

Now type AF.B0 and press RETURN. The computer will again respond, this time printing:

```
00AF- 17
00B0- 08
```

The first pair of numbers (taken in reverse order) means that the program starts at $0801 (decimal 2049), and the second pair means that it ends at $0817 (decimal 2071).

Now enter 800.817 and the bytes which constitute the entire Applesoft program will be displayed as follows:

```
0800-  00 0D 08 05 00 41 D0 31
0808-  3A 42 D0 32 00 15 08 0A
0810-  00 43 D0 33 00 00 00 ??
```

Although the program starts at $801, a $00-byte must occur at $800 (otherwise the Applesoft Interpreter will get upset).

The next two bytes, 0D and 08, point to the location in memory of the start of the next line. These two bytes, or more generally, the first two bytes of any program line, are sometimes referred to as the 'link field', since they link that line to the line which follows (if any).

The next two bytes hold the number of the line, in hexadecimal form, low-byte first, as usual. In this case we have 05 00, that is, $0005 (decimal 5). The line number of the second line is represented at $80F,810 by 0A 00, that is, $000A (decimal 10).

At location $805 begins the storage of the actual text of program line #5. Applesoft conserves space by 'tokenizing' each program word, where possible. That is, words such as 'PRINT' will be stored as a single byte. Spaces between keywords are always eliminated from program lines (although, of course, spaces are not eliminated within PRINT statements, or in a REMark). Examining locations $805 to $80B, you will find the bytes which correspond to 'A = 1: B = 2' (namely: 41 D0 31 3A 42 D0 32). Terminating the line is the end-of-line token, $00.

The second line possesses a similar structure. The program ends with a double-$00 at $815,816. This is the location of what would have been the next link field, pointed to by the first two bytes of the second line of our sample program. This in fact provides one way of identifying the end of an Applesoft program, since you can scan the hex data for a triple zero. (The first zero of the triple zero, you'll remember, is the end-of-line token of the last line of the program.)

When the Applesoft interpreter finds a double zero where it is looking for a link field, it knows that it has reached the end of the program. In the example above, the final end-of-line token is at $814, and the double zero at $815,816. Note that PRGEND ($AF,B0) points to $817, the byte immediately after the last byte of the triple zero (here shown by '??', since it could be anything). Generally pointers to the end of memory blocks point, not to the last byte of the block, but to the byte immediately following.

During the execution of a program, the Applesoft interpreter does not check PRGEND to locate the end of the program. Instead, it simply stops when it comes to the double-zero link field. On the other hand, the SAVE command in DOS does not care where the double-zero (which marks the end of the BASIC portion of the program) is, but simply checks PRGEND to get the address of the end of the program.

This means that we can include extra bytes of information following the double-zero, but before an artificially-high setting of PRGEND, and this information will be SAVEd along with the program. This is how it is possible to append a machine language subroutine to an Applesoft program so that it becomes a permanent part of the program, which can then be SAVEd and LOADed along with the BASIC portion of the program.

USING CALL STATEMENTS IN TOOLBOX COMMANDS

Normally, the pointer that Applesoft uses to indicate the end of the Applesoft program in memory does in fact point at the end of the last line of a program.

However, it is possible to redirect this pointer so that it points to a location some distance after the end of the BASIC lines in a program (see the preceding section). This in effect creates a "pocket" at the end of a program into which may be placed machine language programs.

The beauty of this approach is that when the program is loaded or saved to disk, or even when lines are changed, added or deleted from the program, the pocket within the entire Applesoft program "envelope" (i.e. the portion of memory between the start-of-program and end-of-program pointers) is protected and carried along with the BASIC program.

Once a routine has been appended in this way, the question arises as to how it is to be called by the Applesoft program. If the routine is to be appended to a finished Applesoft program, and that program is always run at the same address in memory, then you could conceivably CALL the routine at a fixed address.

This method, though, is not very practical, since programs are often changed, with the result that the absolute memory locations of any appended routines change accordingly.

Fortunately, there is an alternative. If one machine language routine of length N bytes is appended to the end of an Applesoft program, then the address of the first byte of the routine will always be found at the address of the end of the program minus N. (The term 'program' here means BOTH the BASIC portion together with the appended machine code.) That is to say, one would look at the value contained in PRGEND (the pointer to the end of program: 175,176) to determine the end of the program 'envelope', and then subtract N bytes.

Thus the routine could be called at the address:

```
PEEK(175) + 256 * PEEK(176) - N
```

This address will remain valid despite any changes in the length of the BASIC portion of the program, since the

pointer at locations 175,176 (PRGEND) always points to the end of the program envelope.

This method can be generalized to accommodate more than one appended routine, but to append several routines by hand can be rather tedious. Fortunately, you don't have to, since the Workbench will do it all for you!

Whenever you have added routines to your program using the Workbench, there will also be present a machine language routine which handles the initial part of your Toolbox command. This routine is automatically included in your program when you add the first command.

This routine is known as the 'Interface Routine' because it acts as an interface between your Applesoft program and its appended machine language routines.

It is always placed at the very end of the program envelope, and occupies the last 203 bytes. Thus it can be called at the address:

```
IR = PEEK(175) + 256 * PEEK(176) - 203
```

This is the address set up in line #1 of your program by the EXEC file on the Database Toolbox diskette named CALL SETUP.

When, during the course of the execution of your Applesoft program a Toolbox command is called (by one means or another), the first thing that happens is that control passes to the Interface Routine, which then looks at the command name (between the quotes) in an attempt to find out which particular command you're interested in.

With the name in hand it then searches through the commands added, and if it finds the one you want then the Interface Routine passes control on to that routine.

USING THE AMPERSAND IN TOOLBOX COMMANDS

Although the routines can be called using the CALL statement, there is a more efficient method, using the ampersand.

At locations $3F5-3F7 (decimal 1013-1015) is a JMP instruction (see the Apple][Reference Manual, p. 132). If the address of the Interface Routine is placed into locations 1014 (low byte) and 1015 (high byte), then when the Applesoft interpreter encounters the ampersand

character (&), control will pass to the Interface Routine. As before, the routine will then locate the command that you wish to use, and pass control to it.

Thus in this system there are TWO distinct ways of calling added commands. The effects are the same, and only the syntax of the Toolbox command varies. Below are examples of commands using each of the two methods:

```
CALL IR "SWAP", A$, B$
     & "SWAP", A$, B$

CALL IR "SORT", A$(FE) TO A$(LE)
     & "SORT", A$(FE) TO A$(LE)
```

The two methods have the same result: To call the Interface Routine, which then reads the name of the command, locates it in memory (somewhere between itself and the end of the BASIC portion of your program), and then JMPs to the routine.

If the CALL method is used, it is necessary to have a statement in your Applesoft program which defines the CALL address 'IR'. Such a statement can be inserted in your program (as line #1) by EXECing the file CALL SETUP on the Database Toolbox diskette (with your program in memory, of course).

If the ampersand method is used, then the ampersand vector must be set up to point to the address of the Interface Routine. This can be done by a CALL to an internal entry point in the Interface Routine itself.

This internal entry point is 46 bytes before the end of the Interface Routine, which is itself at the end of your Applesoft program, and so the required ampersand vector setup can be accomplished with a simple

```
CALL PEEK(175) + 256 * PEEK(176) - 46
```

The file AMPERSAND SETUP on the Database Toolbox diskette can be EXECed to insert this line (as line #1) in your program.

Then when your program is run the ampersand hook-up is automatically made and your program can then use the ampersand for added commands without further thought.

It is up to you which method you wish to use to call commands. The ampersand method is more pleasing to the eye, and also involves fewer keystrokes, but it does

modify the ampersand vector which may be used by other utilities. If you wish to use ampersand utilities, you may care to use the CALL IR method of calling Toolbox commands. It is also possible that you might have an ampersand routine that is entirely independent of the Toolbox system. In that case, the CALL IR method will leave the ampersand free for other duties.

If you are still unsure as to the difference between these two methods of calling commands, then simply ignore the existence of the CALL method, and stick to ampersands (they'll never let you down).

USING JUMP FILE CREATE

There is a wealth of relocatable routines available for performing all kinds of tasks in the other Toolbox library disks. Thus normally you will not have to be concerned with interfacing any non-relocatable routine with an Applesoft program. However, it may be that you already have a routine which you have been using at a fixed address and which is not relocatable. Such a routine cannot be used directly as a Toolbox command. There are, however, two possible solutions.

The first is to take your routine and make it relocatable. If this cannot easily be done then there is a utility on the Database Toolbox diskette called JUMP FILE CREATE to provide aid and solace.

Using this utility you can create an intermediate calling routine which will function as a link between the Interface Routine (appended to your Applesoft program) and your non-relocatable routine (occupying its required position in memory).

The only requirement for using JUMP FILE CREATE is that you know the address of the routine which would normally be CALLed (or used via an ampersand).

For example, let's suppose that the file BEEP.TB were a nonrelocatable routine which MUST be loaded at location $300 (decimal 768) to function properly. To create an interface command, run JUMP FILE CREATE.

You will then be presented with the opportunity to enter the call address in decimal. If you do not know the decimal address, press RETURN and a hex option will be presented. For our example, enter '300' as the hex address. It will then print out the decimal equivalent

as a matter of information, and instruct you to press 'S' to save the file.

It will then be saved to the Toolbox diskette as 'JMP.$0300/768.TB'. This Toolbox File could then be added to your program like any other Toolbox File, using the Workbench. If when adding the JMP file, you specify "BEEP" as the command name, then your program could use BEEP.TB as follows :

```
1 CALL PEEK(175) + 256 * PEEK(176) - 46
10 PRINT CHR$(4);"BLOAD BEEP.TB, A$300"
20 INPUT "PITCH,DURATION?  "; P, D
30 & "BEEP", P, D
```

If you wish to write your own machine language routines, the Toolbox system is an ideal way to interface them to an Applesoft program. Be sure to see Appendix D of this manual, which contains more information on writing your own Toolbox commands, and on adapting routines that are found in popular computer magazines to the Toolbox system.

APPENDIX C

WRITING YOUR OWN TOOLBOX COMMANDS

The routines which can be appended to an Applesoft program using the Workbench are not limited to those available on the Toolbox Series of disks. You can also use routines which you may find in any of the numerous Apple-related computer magazines or routines which you create yourself (or have created for you).

PUBLISHED MACHINE LANGUAGE ROUTINES

If you should decide to use a routine listed in a magazine, chances are good that it will work with little or no modification with the Toolbox system.

The main things to keep in mind when selecting additional routines are:

1) Is the routine relocatable?

Machine language programs can be written in two basic forms in regards to this topic. Any program which contains references to absolute memory addresses within itself is not relocatable. This can usually be seen by JSR's and JMP's to internal locations in the listing. Also, the text of the article accompanying the routine may say something like "this routine must be run at location $300 to function properly". If the text indicates that the routine may be placed anywhere in memory, the program is relocatable, and is a good candidate for inclusion in your Toolbox library.

If the routine is not relocatable, it may still be possible to use it with the Toolbox system by creating a jump file command for that routine. See the instructions for the JUMP FILE CREATE utility provided in the Wizard's Toolbox in Appendix B of this manual for more information on this subject.

2) Can the routine be called from a running Applesoft program?

Routines should be executable from within a running Applesoft program without any chance of conflict with Applesoft. The main danger here is that you might come across a routine designed to be used by itself, such as a diskette directory repair routine. In such a case it is possible that certain memory locations used by the routine would be required for use by Applesoft. In

addition, the routine may never "return" with the usual RTS at the end of its operation.

3) Is the routine invoked with the ampersand?

If so, it will usually work fine as a Toolbox command (again, provided that it is relocatable). But beware of routines that require POKEs or other memory setups prior to invoking them.

If the routine satisfies these three criteria then you should have no difficulty in using it as a Toolbox command. If changes are required, or you're inclined to tinker a little, see the following sections for some useful hints.

Note that most ampersand routines do not expect a comma as the first character in the parameter list, whereas a comma IS (usually) the first character in a Toolbox command (unless, of course, the Toolbox command has NO variable list). However, because of a subtle feature of the Interface Routine, the leading comma in a Toolbox command is generally optional.

What this means regarding the adaptation of ampersand routines taken from magazines is as follows: Suppose, for example, that you find in a magazine a routine to swap string variables, and that the routine is invoked by the command & A$, B$. Then the same routine can probably be used as a Toolbox command and can be invoked by EITHER of the following commands: & "SWAP" A$, B$

& "SWAP", A$, B$

This is because the Interface Routine "gobbles" (i.e. move TXTPTR past) any comma occurring immediately after the command name. (For further details on this point see the section "Concluding Notes on Writing Your Own", p.?? of this manual.)

If a published routine expects to find a comma as the first character of the list, then it will normally use a JSR CHKCOM (hex: 20 BE DE) at the start. This should be omitted if the routine is to be used as a Toolbox command, because the comma will be gobbled by the Interface Routine.

IMPORTANT: If you intend to use published routines in your own programs for your own personal use, magazines are a fine source of material. If you add the routines to programs which you intend to sell commercially, it is

highly recommended that you contact the program authors to arrange their consent and cooperation. Many listings from magazines include the phrase "Commercial Rights Reserved" or similar. This must be taken into consideration when including the routines in your own commercially distributed software.

In addition, the following aids to machine language programming are available through Roger Wagner Publishing:

* MERLIN, an extremely powerful, yet easy to use macro assembler. Besides being one of the best assemblers currently available for the Apple, MERLIN offers additional features like Sourceror, which disassembles raw binary code into pseudo source files, and a fully labeled and commented source listing of Applesoft BASIC. MERLIN also uses the upper 16K of memory to become a co-resident assembler with the ability to easily switch between MERLIN and Applesoft.

* MERLIN PRO, the expanded version of Merlin for both DOS 3.3 and ProDOS. Has all the features of Merlin, plus a local labels, and a relocating linker and loader, plus use of the full 128K of RAM on an Apple //e or //c (required).

* MUNCH-A-BUG, an excellent de-bugging package for machine language programs. Allows use of labels and includes its own mini-assembler. Best of all, it can be set in a "waiting" condition to go into the trace mode only after a given routine has been called, thus allowing the user to trace machine code from within fully operational Applesoft programs.

* ASSEMBLY LINES: THE BOOK, is a beginning tutorial on machine language programming. There is a section on creating relocatable code, and also other topics such as sound generation and disk I/O.

* APPLESOFT IN DEPTH, is an extensive study of Applesoft and related routines. Published by CALL -A.P.P.L.E., and also available from Roger Wagner Publishing, this is an invaluable reference book for programmers.

On the other hand, if you are unable or not inclined to delve into what may seem to you the Terra Incognita of assembly language programming, yet find yourself in need of a command to do a certain task, then please contact Roger Wagner Publishing.

Although we do not usually produce custom Toolbox commands, requests of general interest do often result in new Toolbox commands, and we'll be sure to let you know if a command that interests you becomes available.

```
**********************************************************
*  IMPORTANT:  IF  YOU  DO  WRITE  YOUR  OWN ROUTINES,  *
*  PLEASE WRITE ROGER WAGNER PUBLISHING!  WE MAY BE  *
*  ABLE  TO  INCLUDE THE  ROUTINE  ON  FUTURE  TOOLBOX  *
*  COMMAND  LIBRARY  DISKS!  WE CAN ALSO SUPPLY INFOR-  *
*  MATION  AS  TO  WHAT  ROUTINES  ARE CURRENTLY UNDER  *
*  DEVELOPMENT, AND WHICH ARE STILL NEEDED.             *
*                                                       *
**********************************************************
```

AN INTRODUCTION TO THE AMPERSAND

Before looking at how some of the specific Toolbox command routines work, let's first consider how the ampersand vector itself works. Consider this first example:

```
10 PRINT "HELLO"
20 CALL 768
30 PRINT "BYE"
40 NORMAL
```

where, in addition to this Applesoft listing, the following code has been placed at location $300 (768 decimal):

```
0300- 20 80 FE   JSR $FE80
0303- 60         RTS
```

Enter the Applesoft program as listed. Enter the machine language routine by entering:

```
CALL -151
*300: 20 80 FE 60
```

Now RUN the Applesoft program and the words "HELLO" (normal) and "BYE" (in inverse) will appear on the screen.

When a program runs, Applesoft interprets the text of each line by examining each character (or token) on the line, one at a time. It keeps track of where it is at with a pair of zero page bytes, $B8 and $B9 (called TXTPTR for "Text Pointer").

But when a CALL, ampersand (&) or USR statement is encountered, Applesoft is temporarily suspended. In our example, the CALL statement causes a jump to location $300 (decimal 768) at which point is our short machine language routine. At the end of the routine, the usual RTS (Return from SubRoutine) returns control to the Applesoft program. In this regard, the CALL statement is very similar in function to a GOSUB in Applesoft, with the exception that instead of calling an Applesoft subroutine, a machine language routine is used.

At location $300, the JSR $FE80 is a call to the routine which puts the Apple screen display in the inverse mode. Once the return to BASIC is made, any

further text will appear in inverse, until a NORMAL statement is executed.

Now type the sample program as listed here, and run it.

```
 1 POKE 1014,0: POKE 1015,3
10 PRINT "HELLO"
20 &
30 PRINT "BYE"
40 NORMAL : END
```

Although this program should behave in the same way as the first, the manner in which the call to the machine language subroutine at $300 was done has changed. In this program we have used an alternate feature of Applesoft, the ampersand. The ampersand is different from a CALL in that instead of jumping to an address which would otherwise follow a CALL, the address for the jump is determined by looking at locations 1014,1015 ($3F6,3F7), called the "ampersand vector".

The disadvantage of this is that the ampersand will always jump to the same location, unless locations 1014,1015 are specifically changed. The advantage is that the ampersand is much more compact than the CALL 768 statement.

In terms of actual program execution, Applesoft's TXTPTR goes directly to line 30 (or the next statement if there was one) after returning from the ampersand call. The question then arises, "How are routine names and variable passing handled?".

The answer to this question is found in the direct management of TXTPTR by the routine that is called. Consider the statement:

```
20 & "NAME"
```

When Applesoft encounters the ampersand, and passes control to whatever routine is at the address specified by the ampersand vector, TXTPTR is pointing to the first quote of the character string: "NAME". If the called routine does not advance TXTPTR itself and exit with TXTPTR on the '00' at the end of line 20 (or the colon if another statement followed), then a SYNTAX ERROR would occur upon return when TXTPTR tried to analyze "NAME" via the continuing Applesoft program. Try modifying line 20 of the our original sample program as shown above to verify this.

In the case of the Toolbox system, the ampersand vector is pointed at the Interface Routine appended to your program. This Interface Routine when called requires a name to follow the ampersand. By incrementing TXTPTR itself, it can read in the name following the ampersand, and attempt to find the named Toolbox file among the added commands. Once the command routine is found, a jump to the beginning of the routine is done, at which point it is the responsibility of the routine itself to handle any further text following the ampersand and preceding the next colon or end-of-line $00.

For example, consider our simple routine presented earlier. When used directly as an ampersand routine in the first sample listing, the syntax was simple:

```
20 &
```

When used as a routine appended by Workbench, the new syntax would become:

```
20 & "NAME"
```

where "NAME" is the command name given when the routine is added to your program. Remember that the Interface Routine will handle the "NAME" before passing control to your routine.

Try saving the code at $300 as a Toolbox file by placing the Wizard's Toolbox diskette in the drive and typing in:

```
BSAVE INVERSE.TB, A$300, L$4
```

This will save the routine which can now be added to an Applesoft program using the Workbench. The routine can then be called with the Toolbox command:

```
20 & "INV"
```

You could also use any other command name instead of "INV", although it must be the command name you specify when you add the command.

PASSING VARIABLES

The next question is: What about passing variables back and forth? As it happens, this is easier than you might at first suppose. With an elementary knowledge of machine language it is possible to take advantage of the routines already present in Applesoft to do most of the work for us. The best way to illustrate this is with a partial reprint of some articles which appeared in Softalk Magazine, in the column ASSEMBLY LINES, as mentioned earlier.

Although some of the material presented will be somewhat redundant, its repetition is preferred for the continuity of the text. As mentioned earlier, you may wish to read other articles in the series ASSEMBLY LINES or purchase ASSEMBLY LINES: THE BOOK for further information on machine language programming.

ASSEMBLY LINES - JANUARY, 1982

by Roger Wagner

One useful application of machine language programming is in the enhancement of your existing Applesoft programs. Some people are inclined to write all their programs in machine language, but I prefer on occasion to write what I call "hybrids"; that is, programs which are a combination of Applesoft and machine language. In this way, particular functions can be done by the operating system best suited to the particular task.

If I had to write a short program to store 10 names, it would be best to write a short and simple program in Applesoft:

```
10  FOR I = 1 TO 10
20  INPUT N$(I)
30  NEXT I
```

This is much simpler than the equivalent program in machine language. In cases where neither speed nor program size is a concern, Applesoft is a completely acceptable solution.

However, if I had to SORT 1000 names, speed would become a concern, and it would be worth considering whether the job could best be done in machine language.

If you have ever done a 'CALL' in one of your BASIC programs, then you have already combined Applesoft with machine code. For example:

```
10 HOME
20 PRINT "THIS IS A TEST"
30 PRINT "THIS IS STILL A TEST"
40 GET A$
50 HTAB 1: VTAB 5: CALL-958
```

In this program, a line of text is printed on the screen. After pressing a key, all text on the screen after the first word "THIS" is cleared.

Now although it would be possible to accomplish the same effect in Applesoft by perhaps printing many blank lines, it would not be as fast or as efficient code-wise as the CALL -958.

In executing the above program, the Applesoft interpreter goes along carrying out your instructions until it reaches the 'CALL' statement. At that point a JSR is done to the address indicated by the CALL. When the final RTS is encountered, control returns to the BASIC program. In between, however, you can do anything you'd like!

Calling routines is hardly complicated enough to warrant an entire article on the subject. The real question is, how do you pass data back and forth between the two programs, and how can the problem of handling that data be made easier for the machine language program?

SIMPLE INTERFACING

The easiest way to pass data to a machine language routine is to simply POKE the appropriate values into unused memory locations, and then retrieve them when you get to your machine language routine. To illustrate this, let's resurrect the tone routine from the May, 1981 issue of Softalk.

To use this, assemble the code, and place the final object code at $300. Then enter the accompanying Applesoft program.

```
 1  **********************
 2  * SOUND ROUTINE #3A *
 3  **********************
 4  *
 5  *
 6         OBJ  $300
 7         ORG  $300
 8  *
 9  PITCH EQU $06
10  DURATION EQU $07
11  SPKR EQU $C030
12  *
13  BEGIN LDX  DURATION
14  LOOP  LDY  PITCH
15        LDA  SPKR
16  DELAY DEY
17        BNE  DELAY
18  DRTN  DEX
19        BNE  LOOP
20  EXIT  RTS
```

From the Monitor, this will appear as:

```
*300L

0300-   A6 07       LDX   $07
0302-   A4 06       LDY   $06
0304-   AD 30 C0    LDA   $C030
0307-   88          DEY
0308-   D0 FD       BNE   $0307
030A-   CA          DEX
030B-   D0 F5       BNE   $0302
030D-   60          RTS
```

This Applesoft program is used to call it:

```
10 INPUT "PITCH, DURATION? ";P,D
20 POKE 6,P: POKE 7,D
30 CALL 768
40 PRINT
50 GOTO 10
```

The Applesoft program works by first requesting values for the pitch and duration of the tone from the user. These values are then POKE'd into locations 6 and 7 and the tone routine called. The tone routine uses these values to produce the desired sound, and then returns to the calling program for another round.

This technique works fine for limited applications. Having to POKE all the desired parameters into various corners of memory is not flexible, and strings are nearly impossible. There must be an alternative.

THE INTERNAL STRUCTURE OF APPLESOFT

If you've been following this series for long you've no doubt figured out by now that I'm a great believer in using routines already present in the Apple where possible, to accomplish a particular task. Since routines already exist in Applesoft for processing variables directly, why not use them?

To answer this, I must take a brief detour to outline how Applesoft actually "runs" a program.

Consider this simple program:

```
10 HOME: PRINT "HELLO"
20 END
```

After entering this into the computer, typing "LIST" should reproduce the listing given here. An interesting question arises: "How does the computer actually store, and then later execute this program?".

To answer that, we'll have to go to the Monitor and examine the program data directly.

The first question to answer is, exactly where in the computer is the program stored? This can be found by entering the Monitor and typing in:

```
67 68 AF B0  (and pressing RETURN)
```

The computer should respond with:

```
67- 01
68- 08
AF- 18
B0- 08
```

The first pair of numbers is the pointer for the program beginning, bytes reversed of course. They indicate that the program starts at $801. The second pair is the program end pointer, and they show it ends at $818.

Using this information, let's examine the program data by typing in:

```
801L
```

You should get:

```
*801L

0801-   10 08       BPL   $080B
0803-   0A          ASL
0804-   00          BRK
0805-   97          ???
0806-   3A          ???
0807-   BA          TSX
0808-   22          ???
0809-   48          PHA
080A-   45 4C       EOR   $4C
080C-   4C 4F 22    JMP   $224F
080F-   00          BRK
0810-   16 08       ASL   $08,X
0812-   14          ???
0813-   00          BRK
0814-   80          ???
0815-   00          BRK
0816-   00          BRK
0817-   00          BRK
0818-   F9 A2 00    SBC   $00A2,Y
081B-   86 FE       STX   $FE
```

This is obviously not directly executable code. Now type in:

```
801.818
```

This will give:

```
*801.818

0801- 10 08 0A 00 97 3A BA
0808- 22 48 45 4C 4C 4F 22 00
0810- 16 08 14 00 80 00 00 00
0818- 8C
```

To understand this, let's break it down one section at a time. When the Apple stores a line of BASIC, it encodes each keyword as a single byte "token". Thus the word "PRINT" is stored as a $BA. This does wonders for conserving space. In addition, there is some basic overhead associated with "packaging" the line, namely a byte at the end to signify the end of the line, and a few

bytes at the beginning of each line to hold information related to the length of the line, and also the line number itself.

To be more specific:

```
0801- 10 08 0A 00 97 3A BA
0808- 22 48 45 4C 4C 4F 22 00
0810- 16 08 14 00 80 00 00 00
0818- 8C
```

The first two bytes of every line of an Applesoft program are an "index" to the address of the beginning of the next line. At $801,802 we find the address $810 (bytes reversed). This is where line 20 starts. At $810 we find the address $816. This is where the next line would start if there was one. The double '00' at $816 tells Applesoft that this is the end of the BASIC listing. It is important to realize that the '00 00' end of the Applesoft program usually corresponds to the contents of $AF,B0, but not always. It is possible to hide machine language code between the end of the line data and the actual end as indicated by $AF,B0, but more on that later.

The next information within a line is the line number itself:

```
0801- 10 08 0A 00 97 3A BA
0808- 22 48 45 4C 4C 4F 22 00
0810- 16 08 14 00 80 00 00 00
0818- 8C
```

The '0A 00' is the two byte form of the number '10', the line number of the first line of the Applesoft program. Likewise, the '14 00' is the data for the line number '20'. The bytes are again reversed. After these four bytes, we see the actual tokens for each line.

```
0801- 10 08 0A 00 97 3A BA
0808- 22 48 45 4C 4C 4F 22 00
0810- 16 08 14 00 80 00 00 00
0818- 8C
```

All bytes with a value of $80 or greater are Applesoft keywords in token form. Bytes less than $80 represent normal ASCII data (letters of the alphabet, etc.). Examining the data here we see a $97 followed by $3A. $97 is the token for 'HOME', and $3A the colon. Next, $BA is the token for 'PRINT'. This is followed by the quote ($22) and the text for HELLO (48 45 4C 4C 4F) and the closing quote ($22). Last of all, the '00' indicates the end of the line.

In line number 20, the $80 is the token for 'END'. As before, the line is terminated with a '00'.

When a program is executed, the interpreter scans through the data. Each time it encounters a token, such as the PRINT token, it looks up the value in a table to see what action should be taken. In the case of PRINT, this would be to output the characters following the token, namely "HELLO".

This constant translation is the reason for the use of the term "interpreter" for Applesoft BASIC.

Machine code on the other hand is directly executable by the 6502 microprocessor and is hence much faster since no table "lookups" are required.

In Applesoft, a SYNTAX ERROR is generated whenever a series of tokens is encountered that is not consistent with what the interpreter expects to find.

PASSING VARIABLES

So, back to the point of all this. The key to passing variables to your own machine language routines is to work with Applesoft in terms of routines already present in the machine. One of the simplest methods was described in the October, 1981 issue of Softalk, wherein a given variable is the very first one defined in your program (see the input routine). This is ok, but rather restrictive. A better way is to name the variable you're dealing with right in the CALL statement.

The important points here are the two components of the Applesoft interpreter: the TXTPTR and CHRGET (and related routines).

TXTPTR is the two byte pointer ($B8, B9) that points to the next token to be analyzed. CHRGET ($B1) is a very short routine that actually resides on the zero page

which will read a given token into the Accumulator. In addition to occasionally being called directly, many other routines use CHRGET to process a string of data in an Applesoft program line.

Here then is the revised tone routine:

```
 1  **********************
 2  * SOUND ROUTINE #3B *
 3  **********************
 4  *
 5  *
 6     OBJ  $300
 7     ORG  $300
 8  *
 9  PITCH EQU $06
10  DURATION EQU $07
11  SPKR EQU $C030
12  *
13  COMBYTE EQU $E74C
14  *
15  ENTRY  JSR  COMBYTE
16         STX  PITCH
17         JSR  COMBYTE
18         STX  DURATION
19  *
20  BEGIN  LDX  DURATION
21  LOOP   LDY  PITCH
22         LDA  SPKR
23  DELAY  DEY
24         BNE  DELAY
25  DRTN   DEX
26         BNE  LOOP
27  EXIT   RTS
```

This would list from the Monitor as:

```
*300L

0300-   20 4C E7    JSR   $E74C
0303-   86 06       STX   $06
0305-   20 4C E7    JSR   $E74C
0308-   86 07       STX   $07
030A-   A6 07       LDX   $07
030C-   A4 06       LDY   $06
030E-   AD 30 C0    LDA   $C030
0311-   88          DEY
0312-   D0 FD       BNE   $0311
0314-   CA          DEX
0315-   D0 F5       BNE   $030C
0317-   60          RTS
```

The Applesoft calling program would then be revised to read:

```
10 INPUT "PITCH, DURATION? ";P,D
20 CALL 768,P,D
30 PRINT
40 GOTO 10
```

This is a much more elegant way of passing the values and also requires no miscellaneous memory locations as such (although for purposes of simplicity the tone routine itself still uses the same zero page locations.)

The secret to the new technique is the use of the routine COMBYTE ($E74C). This is an Applesoft routine which checks for a comma and then returns a value between $00 and $FF (0-255) in the X-Register.

It is normally used for evaluating POKEs, HCOLOR=, etc., but does the job very nicely here. It also leaves TXTPTR pointing to the end of the line (or a colon if there was one) by using CHRGET to advance TXTPTR appropriate to the number of characters following each comma. Not also that any legal expression such as ´(X-5)/2´ can be used to pass the data.

To verify the importance of managing TXTPTR, try putting a simple RTS ($60) at $300. Calling this you will get a SYNTAX ERROR, since upon return, Applesoft´s TXTPTR will be on the first comma, and the phrase ",P,D" is not a legal Applesoft expression.

Now what about two-byte (values greater than 256) quantities? To do this, a number of other routines are used. For example, this routine will do the equivalent of a two-byte pointer POKE. Suppose for instance you wanted to store the bytes for the address $9600 at locations $1000, 1001. Normally in Applesoft you would do it like this:

```
.
.
.
50 POKE 4096,0: POKE 4097,150
.
.
.
```

Where 4096 and 4097 are the decimal equivalents of $1000 and $1001, and 0 and 150 are the low and high order bytes for the address $9600 ($96 = 150, $00 = 0).

A more convenient approach might be like this:

```
.
.
.
50 CALL 768, 4096, 38400
.
.
.
```

or perhaps:

```
.
.
.
50 CALL 768, A, V
.
.
.
```

The routine for this would be:

```
 1   ***************************
 2   * POINTER SET UP ROUTINE *
 3   ***************************
 4   *
 5   *
 6         OBJ  $300
 7         ORG  $300
 8   *
 9   CHKCOM EQU $DEBE
10   FRMNUM EQU $DD67
11   GETADR EQU $E752
12   LINNUM EQU $50 ; ($50,51)
13   *
14   PTR EQU $3C
15   *
16   ENTRY JSR CHKCOM
17         JSR  FRMNUM    ; EVAL FORMULA
18         JSR  GETADR    ; PUT FAC INTO LINNUM
19         LDA  LINNUM
20         STA  PTR
21         LDA  LINNUM+1
22         STA  PTR+1
23   *
24         JSR  CHKCOM
25         JSR  FRMNUM
26         JSR  GETADR
27   *
28         LDY  #$00
```

```
29          LDA  LINNUM
30          STA  (PTR),Y
31          INY
32          LDA  LINNUM+1
33          STA  (PTR),Y
34    *
35    DONE  RTS
```

Which will list from the Monitor as:

```
*300L

0300-   20 BE DE    JSR   $DEBE
0303-   20 67 DD    JSR   $DD67
0306-   20 52 E7    JSR   $E752
0309-   A5 50       LDA   $50
030B-   85 3C       STA   $3C
030D-   A5 51       LDA   $51
030F-   85 3D       STA   $3D
0311-   20 BE DE    JSR   $DEBE
0314-   20 67 DD    JSR   $DD67
0317-   20 52 E7    JSR   $E752
031A-   A0 00       LDY   #$00
031C-   A5 50       LDA   $50
031E-   91 3C       STA   ($3C),Y
0320-   C8          INY
0321-   A5 51       LDA   $51
0323-   91 3C       STA   ($3C),Y
0325-   60          RTS
```

The special items in this routine include CHKCOM, a syntax checking routine that serves two purposes. First it verifies that a comma follows the CALL address, and secondly it advances TXTPTR to point to the first byte of the expression immediately following the comma. If a comma is not found, a SYNTAX ERROR is generated.

FRMNUM is a routine that evaluates any expression and puts the real floating point number result into Applesoft's "Floating Point Accumulator", "FAC" as it is usually called. This 6 byte psuedo register ($97-9C) is used to hold the floating point representation of a number. It includes such nifties as the exponential magnitude of the number and the equivalent of the digits of the logarithm of the number stored.

At this stage it would be a lot of work to deal with the number in its current form, so the next step is used to convert it into a two byte integer.

GETADR does this by putting the two byte result into LINNUM, LINNUM+1 ($50,51).

Even if this is not exactly an in-depth explanation of all the most precise details of the operation, the bottom line is that the three JSR's (CHKCOM, FRMNUM, and GETADR) will always end up with the low and high order bytes of whatever expression follows a comma in LINNUM and LINNUM+1.

These simple subroutines should be quite adequate for many applications. Next month, however, I'll explain passing strings, some of the various other routines available, and how to pass data back to the calling Applesoft program.

ASSEMBLY LINES - FEBRUARY, 1982

Last month, we began a discussion of how to pass variables back and forth between Applesoft and machine language programs. This month we'll complete the discussion with more information on how all types of variables are handled, and how data can also be passed back to the calling Applesoft program.

APPLESOFT VARIABLES

There are six types of variables in Applesoft BASIC. These consist of REAL, INTEGER, and STRING variables, and their array counterparts. To fully understand how to use these variables, we must first take a moment to examine the differences in each, and how the variables are actually stored in the computer.

Real variables are number values between 10^{38} and -10^{38}, that is to say very large positive and negative numbers. In addition, the values need not be whole numbers; a value such as 1.25 is allowed. Integer variables on the other hand are limited in magnitude to the range of +32768 to -32767. They are also limited to whole number values, i.e. 1,2,3,etc. Values such as 1.25 are not allowed.

Real variables are indicated in BASIC by an alphabetic character (A-Z) followed by a letter or number (A-Z,0-9). Any characters after the first two are ignored when Applesoft looks up the value for the variable. Integer variables are similar, but the name is suffixed by a percent sign (%). Thus 'A' would represent the Real variable, whereas 'A%' would represent an Integer variable.

When passing data such as a memory address or a single byte value to put in memory, Integer variables would be quite adequate and additionally, require no conversion in the machine language routine. However, it is generally more convenient to the BASIC programmer, not to have to put the '%' sign in the variable name, and to instead convert the value using the Applesoft routine "FRMNUM" ($DD67) as described in the last issue. For the record though, I will present an example shortly on how to retrieve an Integer variable from a calling BASIC program.

String variables consist of a series of any legal ASCII characters, with a maximum length of 255 char-

acters. Strings are indicated by a '$' suffix to the variable name.

Any of these variables may be present either singly or in an ARRAY. Arrays are groupings of variables which use a common name, and then a delimiting SUBSCRIPT to identify each individual element. Array variables are indicated by a pair of parenthesis following the variable name, between which a number or expression may be used to specify the desired element.

Although I assume you are already somewhat familiar with the general points mentioned so far, I bring them up not so much to teach you about Applesoft variable types as such, but rather to set the stage for what is to follow, namely how each of these variable types is stored within the memory of the Apple computer.

MEMORY MAPS

Quite some time ago I presented a graphic representation of the memory usage of the computer. I would like to revive the topic in the interest of our current subject.

A memory map is used to show the relative placement of data within the available memory locations within the computer. Recall that there are a total of 65,536 locations available, which we identify with hexadecimal addresses of $0000 to $FFFF.

The chart below shows how a normal Apple would be shown, with DOS booted, and an arbitrary Applesoft program in memory.

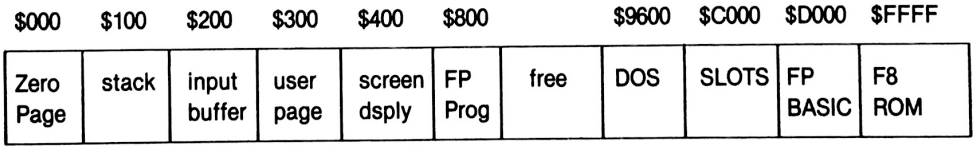


fig. 1

In previous articles, the areas shown have been desribed in varying degrees of detail. You'll recall that the area from $C000 to $CFFF is reserved for the interface card addressing, and that Applesoft BASIC is stored in ROM, beginning at $D000. The Monitor ROM begins at $F800.

A normal Applesoft program starts at $800, with the highest available address usually being $9600, which is identified with the lower boundary of the Disk Operating System (DOS).

The area from $300 to $3CF is availabe for user machine language programs. $3D0 to $3FF is reserved for Apple system vectors, such as the DOS entry vectors. Zero page, the stack, and the input buffer have also been discussed in some detail.

Since our main concern is in the area of Applesoft variables, let's consider a revised map, emphasizing Applesoft programs:

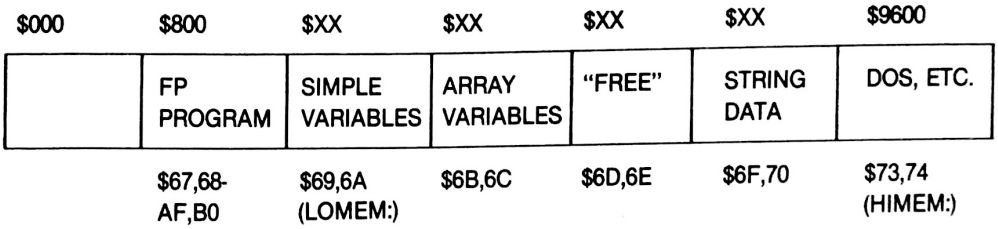


fig. 2

Fig. 2 shows that when an Applesoft program is run, simple (non-array) variables are placed immediately after the end of the BASIC program, followed by the array variables. Because the data for each string variables is always changing in lengt , string data is stored dynamic-ally at the top of memory, working down. The space in between these converging areas is the so-called "free space" of the system.

HIMEM: and LOMEM: are used by the BASIC programmer to set the upper and lower bounds of variable storage. If not specifically declared within the program, these default to the bottom of DOS and the end of the Applesoft program, respectively. They DO NOT, however, always have to be restricted to these locations.

It is possible to move LOMEM: up, or HIMEM: down, so as to set aside a portion of memory in the computer which will not be affected by the running program. This is done for one or both of two reasons. First, to protect either or both of the HI-RES display pages from variable table encroachment, or second, to provide a protected area for a user's machine language program.

Now that we know where the information for each variable is stored in the computer, let's examine the format of the information for each variable. Within the areas indicated, a variable table is constructed which contains the name of the given variable, and its value if the variable is a real or integer. If the variable is a string, a pointer is stored which indicates exactly where at the top of memory the string is stored, and its corresponding length (0-255 characters).

Fig. 3 summarizes the details of the format for these tables:

Variable Type/Storage Format

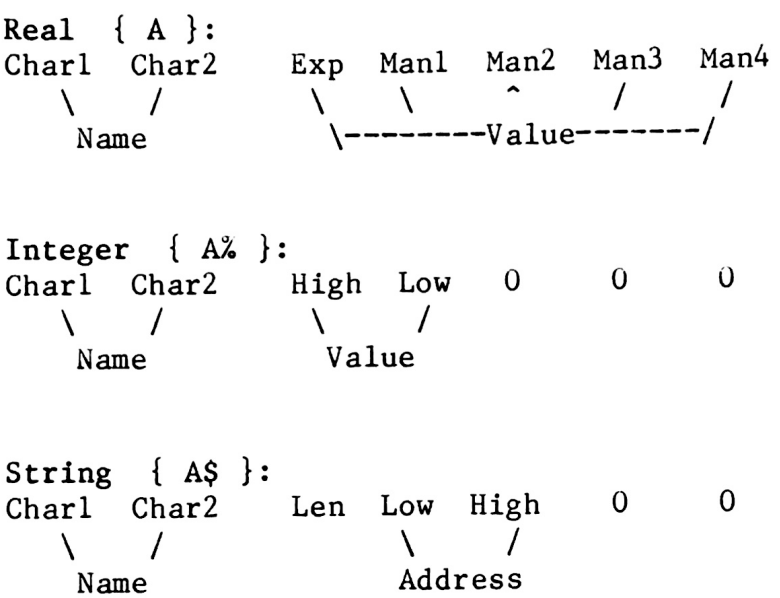


Fig. 3

Each time a variable is first encountered in a running Applesoft program, an entry in the variable table is made for it. For simple variables, Applesoft looks to the pointer at $6B,6C to see where the end of the current simple variable table is. It then opens up 7 bytes for the new variable and puts a block of data similar to that shown in fig. 3, as is appropriate to the type of variable defined.

Real variables store the value in a logarithmic form, where each value is indicated by the exponent and four mantissas. Integer variables require only the high and low order bytes of the value be stored. The remaining three positions are unused, with dummy '0' values placed in the table. It is important to note here that for

integer variables, the two byte representation of the value is reversed from what we would normally expect. That is to say, the high order byte is placed first, followed by the low order byte.

For strings only three bytes of information are required, namely the length and address data mentioned earlier. Again the last two positions are filled with dummy '0's.

It should be evident from this table that the same amount of memory is allocated for all simple variable types, i.e. there is no advantage in specifying integer variables vs. reals to save memory. This will not be the case with arrays.

Notice that there are two distinct parts to each 7 byte variable entry. The first two bytes define the name, where incidentally, the high order byte is used in each character to indicate which of the three variable types (real, integer or string) that entry corresponds to. The last five bytes make up the actual data for each variable, and consists of either the required numeric information, or if it's a string, the length and address information.

The reason I mention this distinction is that in examining arrays, we notice that it is this five byte block that gets repeated a large number of times, depending on the total number of elements in the array.

For arrays a much larger table needs to be constructed, and this is created starting at the address indicated by $6B,6C. Whenever a new array is defined, the pointer at $6D,6E is examined to determine the end of the current array table, and a new entry made, according to the format shown in Fig. 4.

In this format, the entry is given a "header" that gives the variable name, followed by an offset value used to determine the address of the next array entry, if one is present. The offset is encoded in the usual two byte manner. Following the offset is is a byte indicating the number of dimensions in the array, after which is then listed a byte for each dimension stating its size. Although not shown in the diagram, each size indicator is a two byte pair, although in this case the high byte is always given first.

Immediately after the header is found the actual data blocks, each block consisting of 5, 2 or 3 bytes per array element, depending on which variable type is involved. Note that in this case, integer variable arrays do take much less memory than an equivalent real array.

Variable Type/Storage Format

Real Arrays: A(d1,d2,...,dn)

```
Char1  Char2  OSL  OSH   Num   dn ... d1  [5 Byte blocks]
  \     /      \    /     ^      \    /     \           /
   Name         Offset  # of Dims  Sizes     Actual Data
```

Integer Arrays: A%(d1,d2,...,dn)

```
Char1  Char2  OSL  OSH   Num   dn ... d1  [2 Byte blocks]
  \     /      \    /     ^      \    /     \           /
   Name         Offset  # of Dims  Sizes     Actual Data
```

String Arrays: A$(d1,d2,...,dn)

```
Char1  Char2  OSL  OSH   Num   dn ... d1  [3 Byte blocks]
  \     /      \    /     ^      \    /     \           /
   Name         Offset  # of Dims  Sizes     Actual Data
```

Fig. 4

As an example, if you were to dimension an array with this statement: DIM A$(10,10)

The header block would look like this:

```
$41  $80  $74  $01  $02  $00 $0B  $00 $0B [3 Byte blocks]
 \    /    \    /    ^      \         /      \         /
  Name     Offset  Dims.       Sizes          Actual Data
```

Fig. 5

Where $41,80 are the ASCII values for an 'A' followed by a null. High bit is off in the first character, on in the second, indicating a string. The next array variable would be found at the address of the first name character plue $174. There are two dimensions to the array, indicated by the $02. The $00 $0B indicates ELEVEN elements in each dimension of the array. This should not be surprising when you recall that '10' plus the '0'th position makes eleven elements.

Following this header we would find 121 three-byte blocks, each indicating the length and address of a string array element, if present. (11 x 11 = 121; (121 * 3) + 9 (header) = 372 = $174!)

PASSING VARIABLES FROM APPLESOFT TO MACHINE LANGUAGE

At this point you may well think that we have strayed very far from the topic of machine language programming, and have become overly involved with the structure of Applesoft. Upon a little reflection however, it should become apparent that we must have some familiarity with how these variables are stored if we are to successfully interact with them.

In either reading or creating Applesoft variables, clearly we must effectively handle each component of the data. We must be able to identify the name and location of the variable we are interested in, and to also modify that information if necessary.

The temptation at this point might be to take this new found knowledge and write our own routines to accomplish the needed operations independent of Applesoft, but I assure your such an undertaking would be quite unnecessary, not to mention likely to have you mindlessly babbling to yourself in no time.

Fortunately Applesoft already contains all of the necessary routines to do almost anything we wish. The main trick will be to properly identify and use the appropriate ones.

Last month I made use of a few of these to accomplish a certain degree of flexibility in passing numeric data to a machine language routine. Let's complete the study by formalizing the possible operations.

The first general category is passing data to a routine. We can pass any of six variable types. To

minimize the confusion, let us establish a fairly simple goal: to successfully pass the data, and prove so by storing the data in a non-Applesoft location.

INTEGER VARIABLES

First for integer variables. The calling Applesoft program looks like this:

```
10  A% = 258
20  CALL 768,A%
30  PRINT PEEK(896),PEEK(897)
40  REM 896,897 = $380,381
50  END
```

The machine language routine should be be assembled from this listing:

```
                    1    ****************
                    2    * INT VARIABLE  *
                    3    *    READER     *
                    4    *    2/1/82     *
                    5    ****************
                    6    *
                    7    *
                    8              OBJ  $300
                    9              ORG  $300
                   10    *
                   11    CHKCOM    EQU  $DEBE
                   12    PTRGET    EQU  $DFE3
                   13    VARPNT    EQU  $83
                   14    MOVFM     EQU  $EAF9
                   15    CHKNUM    EQU  $DD6A
                   16    DATA      EQU  $380
                   17    *
0300: 20 BE DE     18    ENTRY     JSR  CHKCOM ; CHK SYNTAX
0303: 20 E3 DF     19              JSR  PTRGET ; FIND VARIABLE
                   20    * Y,A = ADDR OF VALUE
0306: 20 F9 EA     21              JSR  MOVFM  ; MOVE VAL-> FAC
0309: 20 6A DD     22              JSR  CHKNUM ; FAC = NUM?
030C: A0 00        23              LDY  #$00
030E: B1 83        24              LDA  (VARPNT),Y
0310: 8D 81 03     25              STA  DATA+1
0313: C8           26              INY
0314: B1 83        27              LDA  (VARPNT),Y
0316: 8D 80 03     28              STA  DATA
                   29    *
                   30    * NOTE! HIGH BYTE FIRST!
```

```
                31   *
0319: 60        32   DONE     RTS
```

In this routine, CHKCOM ($DEBE = "Check for Comma") is used to make sure the syntax is correct (ie. a comma), and to advance TXTPTR ($B8 = "Text Pointer") to the first byte of the variable name being evaluated. Refer to last month's issue for the original discussion on these two routines.

PTRGET ($DFE3 = "Pointer Get") is now called, which is a subroutine which reads a variable name in and then locates it in the variable table. As an added bonus, if the variable named does not currently exist in the table, it will create an entry for it. This applies to variables of all six types.

After returning from PTRGET, the address of the value for the variable is held in the Y-Register and the Accumulator (low byte, high byte). This thus indicates the location in memory of the 2 to 5 byte data block discussed earlier. The data in the Y-Register and Accumulator is also duplicated in VARPNT, VARPNT+1 ($83,84 = "Variable Pointer"), which will be used later in the program.

At this stage it would be a simple matter to use indirect addressing to retrieve the two bytes, but a little more effort will result in a much more thorough routine. It is possible that the user might have called the routine with an improper variable type following the CALL statement, such as a string. This can be checked for by the next two program steps.

MOVFM ($EAF9 = "Move to FAC from Memory") will move whatever data is pointed to by the Y-Register and the Accumulator into the Floating Point Accumulator ($F9-A2 = "FAC"). The contents can then be checked for variable type by the call to CHKNUM ($DD6A = "Check Number"). The presence of a string here would yield a TYPE MISMATCH ERROR. Unfortunately, it is not particularly easy to test for a real variable having been mistakenly used here.

Presuming no error occurs, we will now make use of the data saved in VARPNT (since the Y-Register and Accumulator have been no doubt altered by MOVFM and CHKSTR) to actually retrieve the two byte value passed. The indirect addressing mode is now used to move the variable data into our two DATA bytes. The address of

$380,381 was in this case arbitrarily chosen for the example.

It is important to note that special care is used in lines 25 and 28, since integer variables store the two data bytes high order byte first, as mentioned earlier. This is opposite to the normal 6502 convention.

This routine will work equally well for retrieving data from both simple integer variables and integer array variables.

When you run this example, the numbers "2" and "1" should be printed out, these being the low and high order bytes of the number passed to the routine (258 = $102).

REAL VARIABLES

Once in machine language, the handling of floating point numbers, such as represented by real variables is somewhat involved. Additionally, the majority of the time you will be concerned only with passing an integer between 0 and 65535. Therefore, we will consider here how to use a real variable to pass a number in this range to a given subroutine.

This revision of our first Applesoft program will do the trick:

```
10  A = 258
20  CALL 768,A
30  PRINT PEEK(896),PEEK(897)
40  REM 896,897 = $380,381
50  END
```

The assembly language program for this is:

```
1    ****************
2    * REAL VARIABLE *
3    *    READER     *
4    *    2/1/82     *
5    ****************
6    *
7    *
8              OBJ  $300
9              ORG  $300
10   *
11   CHKCOM    EQU  $DEBE
12   FRMNUM    EQU  $DD67
```

```
                  13  GETADR   EQU  $E752
                  14  LINNUM   EQU  $50
                  15  DATA     EQU  $380
                  16
0300: 20 BE DE    17  ENTRY    JSR  CHKCOM ; CHK SYNTAX
0303: 20 67 DD    18           JSR  FRMNUM ; EVALUATE NUM
0306: 20 52 E7    19           JSR  GETADR ; FAC -> INT
0309: A5 50       20           LDA  LINNUM
030B: 8D 80 03    21           STA  DATA
030E: A5 51       22           LDA  LINNUM+1
0310: 8D 81 03    23           STA  DATA+1
0313: 60          24  DONE     RTS
```

This is basically a repeat of last month's routine, with the results being put in DATA,DATA+1. The advantage of this routine is that not only is it shorter, but it will accept either integer or real variables (simple or array), and still do the string error check. This then is usually the preferred method.

STRING VARIABLES

The goal here will be to read some string data from the calling Applesoft program, and to then put it somewhere in memory, where it would presumably be available to other portions of the machine language program. To illustrate this, enter the following two programs:

```
10  A$ = "TEST"
20  CALL 768,A$
30  END
```

```
1   ********************
2   * STR$ VAR READER *
3   *     2/1/84      *
4   *   R. WAGNER     *
5   ********************
6   *
7   *
8   *         OBJ  $300
9               ORG  $300
10  *
11  CHKCOM    EQU  $DEBE
12  FRMEVL    EQU  $DD7B
13  FRESTR    EQU  $E5FD
14  INDEX     EQU  $5E          ; $5E,5F
15  DATA      EQU  $380
16  *
```

```
0300: 20 BE DE  17   ENTRY   JSR  CHKCOM      ; CHK
                                                 SYNTAX
0303: 20 7B DD  18           JSR  FRMEVL      ; EVALUATE
                19   *
0306: 20 FD E5  20           JSR  FRESTR      ; VAR = $?
                21   *                       ; IF SO,
                                                 MAKE ROOM
0309: A8        22           TAY              ; PUT LEN
                                                 IN Y
                23   *
030A: 88        24   LOOP    DEY
030B: B1 5E     25           LDA  (INDEX),Y   ; GET CHR
030D: 99 80 03  26           STA  DATA,Y      ; PUT CHARS
                                                 IN BUFFER
0310: C0 00     27           CPY  #$00        ; ARE WE
                                                 DONE?
0312: D0 F6     28           BNE  LOOP        ; NOPE
                29   *
0314: 60        30   DONE    RTS
```

After running the calling program, enter the Monitor, and list out the DATA region of memory with:

```
*380.383 <RETURN>
```

This should print out the following data:

```
0380- 54 45 53 54
```

This shows that the hex values for the characters "TEST" have been successfully transferred. Let's see how it was accomplished.

The routine starts off rather like the previous ones by using CHKCOM to make sure a comma was used after the CALL and to prepare TXTPTR for reading in the data. FRMEVL ($DD78 = "Formula Evaluation") is a very nice general purpose routine which takes in virtually any numeric or string expression or literal, and places the final result in FAC. It is related to FRMNUM, but is much more omnivorous.

Upon returning from FRMEVL, we then use FRESTR (for "FREe STRing") to check to make sure the expression or variable was a string, and if so, make room in memory to store the result (if needed). The great thing about this pair of operations is that they come back with the length of the final string in the accumulator, and the address of the beginning of the string characters in INDEX ($5E,5F).

All that remains is to transfer the value for the length into the Y Register (line 22), and then enter the loop that moves the data from it's location, indicated by INDEX, to our DATA address. Remember that for a length of '4', for example, we would want Y to go through the range of 0 to 3. Therefore, the DEY at the top of the LOOP routine fits right into our plans by subtracting 1 from the length value as we start the data transfer.

The transfer loop counts backwards from 3 down to 0 just for the sake of efficiency. We could also have put the length in some memory location, started with Y = 0, and then compared Y with the length within the loop to determine when we were done. In experimenting with your own strings, notice that the area from $380 to $3CF is open, but starting at $3D0, the area is reserved for DOS.

Entering very long strings in the example may lead to some problems. In your own programs it would be necessary to set aside a one page area ($100 = 256 bytes) to put the data, unless of course you can limit the length of the string before doing the CALL.

You may also wish to try variations in the Applesoft program by deleting line 10 and rewriting line 20 as:

```
20 CALL 768,"ABC" + "DEF"
```

or

```
20 CALL 768,LEFT$("ABCDEF")
```

or

```
10 A$(5,5) = "TEST"
20 CALL 768,A$(5,5)
```

PASSING DATA FROM MACHINE LANGUAGE TO APPLESOFT VARIABLES

The converse of the techniques we've discussed so far is actually fairly simple. The key to much of it is the PTRGET routine that was used earlier. Because this routine will even create a variable if it's not already present, we can simply more or less reverse the process of the previous routines to pass data back to a calling Applesoft program.

Again, I'll illustrate an example for each variable type.

INTEGER VARIABLES

The Applesoft program:

```
10 POKE 896,2: POKE 897,1
20 CALL 768,A%
30 PRINT A%
40 END
```

The machine subroutine to be called is:

```
                1  ****************
                2  * INT VARIABLE  *
                3  *    SENDER     *
                4  *    2/1/82     *
                5  ****************
                6  *
                7  *
                8           OBJ  $300
                9           ORG  $300
               10 *
               11 CHKCOM    EQU  $DEBE
               12 PTRGET    EQU  $DFE3
               13 VARPNT    EQU  $83
               14 MOVFM     EQU  $EAF9
               15 CHKNUM    EQU  $DD6A
               16 DATA      EQU  $380
               17 *
               18 ENTRY     JSR  CHKCOM  ; CHK SYNTAX
               19           JSR  PTRGET  ; FIND VARIABLE
               20   * Y,A = ADDR OF VALUE
0306: 20 F9 EA 21           JSR  MOVFM ; MOVE VAL -> FAC
0309: 20 6A DD 22           JSR  CHKNUM ; FAC = NUM?
030C: A0 00    23           LDY  #$00
030E: AD 81 03 24           LDA  DATA+1
0311: 91 83    25           STA  (VARPNT),Y
0313: C8       26           INY
0314: AD 80 03 27           LDA  DATA
```

```
0317: 91 83     28          STA  (VARPNT),Y
                29   *
                30   * NOTE! HIGH BYTE FIRST!
                31   *
0319: 60        32   DONE   RTS
```

This program is a rather trivial exercise in that all that need be done is to reverse the operands of lines 24,25 and 27,28 from the first Integer Reader program. Again, the only caution is to make sure the bytes are transferred in the proper order, since integer data is reversed.

REAL VARIABLES

Real variables require the introduction of a few new routines. The same Applesoft calling program is used with only a minor modification.

```
10 POKE 896,2: POKE 897,1
20 CALL 768,A
30 PRINT A
40 END
```

The subroutine is entered as:

```
                 1  ******************
                 2  * REAL VARIABLE *
                 3  *    SENDER     *
                 4  *    2/1/82     *
                 5  ******************
                 6  *
                 7  *
                 8           OBJ  $300
                 9           ORG  $300
                10 *
                11 CHKCOM    EQU  $DEBE
                12 PTRGET    EQU  $DFE3
                13 CHKNUM    EQU  $DD6A
                14 GIVAYF    EQU  $E2F2
                15 MOVMF     EQU  $EB2B
                16 DATA      EQU  $380
                17 *
0300: 20 BE DE  18 ENTRY     JSR  CHKCOM ; CHK SYNTAX
0303: AC 80 03  19           LDY  DATA
0306: AD 81 03  20           LDA  DATA+1
0309: 20 F2 E2  21           JSR  GIVAYF ; DATA -> FAC
030C: 20 E3 DF  22           JSR  PTRGET ; LOCATE VAR
030F: 20 6A DD  23           JSR  CHKNUM ; VAR = #?
                24 * Y,A = ADDR OF VAR DATA
0312: AA        25           TAX
```

```
0313: 20 2B EB 26          JSR  MOVMF ; PUT FAC->MEMORY
0316: 60       27 DONE     RTS
```

The technique here is to use the routine GIVAYF ($E2F2 = "Give Acc & Y-Reg to FAC") to put the two bytes of our integer number into the FAC. GIVAYF requires that The Accumulator and Y-Register be loaded with the high and low order bytes, respectively, for the integer number to be transferred. As an added bonus, the number may even be "signed", that is positive or negative. Note that by using GIVAYF, numbers greater than 32767 will be returned as negative values. Signed binary numbers were briefly touched upon in an earlier issue, and are covered in greater detail in the book version of this series.

Lines 19 & 20 load the appropriate registers, and after calling GIVAYF and PTRGET are used to determine the name of the variable to use in returning the data. CHKNUM is then called to make sure it's a numeric variable (as opposed to a string). Recall that after returning from PTRGET, the Y-Register and Accumulator will hold the low and high order bytes of the address of the data for the new variable digested by PTRGET.

MOVMF ($EB2B = "Move to Memory from FAC") is the routine we'll use to complete the process. It requires that the high order and low order bytes of the address of the memory location to which the FAC will be moved be put in the X-Register and Y-Register, respectively.

Since PTRGET has just determined that for us, the only hitch is that PTRGET left the high order byte in the Accumulator instead of the X-Register as we require. A simple TAX solves that problem, and the routine is concluded with the call to MOVMF and an RTS.

PROGRAMMING TIP: Whenever a routine ends with a 'JSR' to another routine, immediately followed by the ending RTS of the main routine, the listing can be shortened one byte by changing the last JSR to a JMP.

When the RTS in the last called subroutine is encountered, the RTS will cause an exit from the main routine instead. An example of this would be to rewrite the end of the program just listed as:

```
                .
                .
                .
030F: 20 6A DD 23          JSR  CHKNUM ; VAR = #?
               24 * Y,A = ADDR OF VAR DATA
0312: AA       25          TAX
```

```
0313: 4C 2B EB 26 DONE      JMP  MOVMF ; PUT FAC ->
                                         MEMORY AND
                                         RETURN!
```

STRING VARIABLES

String variables are not much different, but will require a slightly clumsy calling Applesoft program to demonstrate. Line 10 is a series of ´POKE´s which will put the ASCII data for the string "TEST" into memory at our usual DATA ($380) location.

Additionally, a delimiter will be placed at the end of the string so that the routines we will be calling can determine the string´s length. Use of a delimiter is more practical especially in situations where you don´t know the length of an incoming string until the carriage return or other delimiter shows up. The Applesoft routine we´ll be using will automatically determine the length by scanning the string for the delimiter.

```
10 POKE 896,84: POKE 897,69: POKE 898,83:
   POKE 899,84: POKE 900,0
20 REM "TEST" + NULL DELIMITER
30 CALL 768, A$
40 PRINT A$
50 END
```

The subroutine for this is:

```
                1    ********************
                2    * STR$ VAR SENDER *
                3    *     2/1/82       *
                4    *    R. WAGNER     *
                5    ********************
                6    *
                7    *
                8              OBJ  $300
                9              ORG  $300
               10    *
               11    CHKCOM   EQU  $DEBE
               12    PTRGET   EQU  $DFE3
               13    CHKSTR   EQU  $DD6C
               14    FORPNT   EQU  $85
               15    MAK$     EQU  $E3E9
               16    SAVD     EQU  $DA9A
               17    DATA     EQU  $380
               18    *
               19    *
0300: 20 BE DE 20    ENTRY    JSR  CHKCOM ; SYNTAX?
0303: 20 E3 DF 21             JSR  PTRGET ; FIND VAR
```

```
0306: 20 6C DD 22              JSR  CHKSTR ; VAR = $?
0309: 85 85    23              STA  FORPNT
030B: 84 86    24              STY  FORPNT+1 ; ADR OF DESCR
030D: A9 80    25              LDA  #$80
030F: A0 03    26              LDY  #$03 ; A,Y = $380
0311: A2 00    27              LDX  #$00 ; DELIMITER = '00'
0313: 20 E9 E3 28              JSR  MAK$ ; DATA -> MEMORY
0316: 20 9A DA 29              JSR  SAVD ; VARPNT= NEW STRG
0319: 60       30    DONE      RTS
```

The new routines here are MAK$ ($E3E9 = "Make string") and SAVD ($DA9A = "Save Descriptor"). MAK$ requires that the Accumulator and the Y-Register hold the address (low, high) of the string to be scanned, and that the X-Register hold the value for the delimiting character. I have used '00' in this example, but another common variation would be to use a carriage return ($8D) or a comma ($2C). (Note that RETURN is almost always found in the input buffer with the high bit SET, ie. $8D vs. $0D).

After scanning for the delimiter, MAK$ moves the data up to the string storage area at the top of memory.

SAVD is a companion routine which will take whatever string descriptor is currently pointed to by FORPNT ($85,86 = "Formula Pointer(?)"), and match it to the data just moved by MAK$.

Looking at the listing, we can see that the only creative work that needs to be done is to move the contents of A and Y to FORPNT. The A, Y, and X registers are then prepared, as was just described, and the remaining calls done. Voila! Instant strings!

CLOSING STUFF

You'll notice that all of the routines handle arrays as well as simple variables. Additionally, certain more subtle points may become apparent as you study the listings.

For example, each of the last three Applesoft listings was done without defining the returned variable prior to the CALL. This was to demonstrate that PTRGET does a very nice job of creating the variable for us. In addition, in each case, the data put into a variable, and then later retrieved at DATA (and vice versa) should be consistent, thus demonstrating the accuracy of the methods.

You may also wish to experiment with using formulas or string calculations after the CALL statement, to confirm that all legal Applesoft operations are acceptable.

CONCLUDING NOTES ON WRITING YOUR OWN

If you wish to write your own machine language routines for use with the Toolbox Series, then the first requirement is a good assembler (such as Roger Wagner Publishing's MERLIN). Techniques of assembly language programming can be learned by studying the relevant articles in the computer magazines and the occasional helpful book. From then on you have to rely on your own ingenuity.

Routines for use with the Toolbox system should be relocatable (that is, executable at any location in memory). This simply means that you must not refer to any memory locations within your routine (such as with internal JSRs). References to external subroutines in the Apple Monitor ($F800-$FFFF), Applesoft ($D000-$F7FF) and DOS ($9D00-$BFFF on a 48K Apple) are OK.

In fact, there are so many useful routines available in the Applesoft and Monitor ROMs, that most of your work has already been done for you, and it is simply a matter of learning what routines are available and how to use them. We highly recommend the book "All About Applesoft", published by Call -A.P.P.L.E. and also available from Roger Wagner Publishing.

A Toolbox command routine should begin by reading the variable list (if any) in the command syntax.

At that point your routine simply has to go through the bytes in the program text which follow the command name, using the same routines (PTRGET, CHKCOM, COMBYTE, FRMEVL, FRMNUM, CHRGET, SYNCHR, etc.) that Applesoft itself uses when interpreting a program line.

If a syntax error (as defined either by Applesoft or by yourself) or some other error, such as a type mismatch error, occurs then the appropriate Applesoft error message can be generated immediately. If the syntax is correct, and the values of the variables are acceptable, then the routine can proceed with its appointed task.

When reading the variable list it is essential to keep track of where TXTPTR ($B8,B9) is pointing. The routine CHRGOT (at $B7) will load the accumulator with

whatever byte TXTPTR is pointing to, and CHRGET (at $B1) will advance TXTPTR to the next byte and load it into the accumulator. If the byte loaded is a colon ($3A) or an end-of-line token ($00) then both CHRGOT and CHRGET return with the zero flag set; this is how you can tell when you have reached the end of the variable list.

There is one feature of the Interface Routine which is important to understand in this connection: If the first byte in the variable list is a comma then the Interface Routine will move TXTPTR past it before it passes control to your routine. In this case TXTPTR will be pointing to the byte immediately following the comma when control passes to your routine. If there is no variable list following the command name, or if there is a variable list but its first byte is not a comma, then when control passes to your routine TXTPTR will be pointing to the byte immediately following the second quote (") in the command name.

When debugging a machine language routine it is usually essential to know its precise location in memory. Thus it is better to test your routine at a fixed location in memory (e.g. $300 if it is short) BEFORE appending it to an Applesoft program as a Toolbox command. If a relocatable routine functions properly at a fixed location then it will also function properly as a Toolbox command.

The only complication here is that, if the variable list that your routine will read has an initial comma (as is usually the case), then you must allow for the fact that (when your routine is installed as a Toolbox command) this comma will be gobbled by the Interface Routine. It has been found in practice that when debugging a routine by CALLing it at a fixed location it is best to adopt the method of adding a JSR CHKCOM at the start to gobble the comma in the variable list (but don't include this JSR CHKCOM in the final routine).

The Interface Routine is so designed that when your routine receives control it may find its own address in the zero page locations $5E,5F. This allows you to access data bytes (e.g. text) within your routine, which is normally not possible in a relocatable routine.

End your routine as usual with an RTS (or a JMP to an external routine which itself ends with an RTS). Control will then return to the Applesoft Interpreter, which will then proceed to execute the statement immediately following your new Toolbox command.

APPLESOFT TOKEN CHART

DEC	HEX	CHR	DEC	HEX	CHR	DEC	HEX	CHR	LOWER CASE
0	0	^@	43	2B	+	85	55	U	
1	1	^A	44	2C	,	86	56	V	
2	2	^B	45	2D	-	87	57	W	
3	3	^C	46	2E	.	88	58	X	
4	4	^D	47	2F	/	89	59	Y	
5	5	^E	48	30	0	90	5A	Z	
6	6	^F	49	31	1	91	5B	[	
7	7	^G	50	32	2	92	5C	\	
8	8	^H	51	33	3	93	5D	]	
9	9	^I	52	34	4	94	5E	^	
10	A	^J	53	35	5	95	5F		
11	B	^K	54	36	6	96	60	Spc	(`)
12	C	^L	55	37	7	97	61	!	(a)
13	D	^M	56	38	8	98	62	"	(b)
14	E	^N	57	39	9	99	63	#	(c)
15	F	^O	58	3A	:	100	64	$	(d)
16	10	^P	59	3B	;	101	65	%	(e)
17	11	^Q	60	3C	<	102	66	&	(f)
18	12	^R	61	3D	=	103	67	'	(g)
19	13	^S	62	3E	>	104	68	(	(h)
20	14	^T	63	3F	?	105	69	)	(i)
21	15	^U	64	40	@	106	6A	*	(j)
22	16	^V	65	41	A	107	6B	+	(k)
23	17	^W	66	42	B	108	6C	,	(l)
24	18	^X	67	43	C	109	6D	-	(m)
25	19	^Y	68	44	D	110	6E	.	(n)
26	1A	^Z	69	45	E	111	6F	/	(o)
27	1B	Esc	70	46	F	112	70	0	(p)
28	1C	^\	71	47	G	113	71	1	(q)
29	1D	^]	72	48	H	114	72	2	(r)
30	1E	^^	73	49	I	115	73	3	(s)
31	1F	^_	74	4A	J	116	74	4	(t)
32	20	Spc	75	4B	K	117	75	5	(u)
33	21	!	76	4C	L	118	76	6	(v)
34	22	"	77	4D	M	119	77	7	(w)
35	23	#	78	4E	N	120	78	8	(x)
36	24	$	79	4F	O	121	79	9	(y)
37	25	%	80	50	P	122	7A	:	(z)
38	26	&	81	51	Q	123	7B	;	({)
39	27	'	82	52	R	124	7C	<	(|)
40	28	(	83	53	S	125	7D	=	(})
41	29	)	84	54	T	126	7E	>	(~)
42	2A	*				127	7F	?	Rubout

^A = control-A, etc.

DEC	HEX	CHR	DEC	HEX	CHR	DEC	HEX	CHR
128	80	END	171	AB	GOTO	214	D6	FRE
129	81	FOR	172	AC	RUN	215	D7	SCRN(
130	82	NEXT	173	AD	IF	216	D8	PDL
131	83	DATA	174	AE	RESTORE	217	D9	POS
132	84	INPUT	175	AF	&	218	DA	SQR
133	85	DEL	176	B0	GOSUB	219	DB	RND
134	86	DIM	177	B1	RETURN	220	DC	LOG
135	87	READ	178	B2	REM	221	DD	EXP
136	88	GR	179	B3	STOP	222	DE	COS
137	89	TEXT	180	B4	ON	223	DF	SIN
138	8A	PR#	181	B5	WAIT	224	E0	TAN
139	8B	IN#	182	B6	LOAD	225	E1	ATN
140	8C	CALL	183	B7	SAVE	226	E2	PEEK
141	8D	PLOT	184	B8	DEF	227	E3	LEN
142	8E	HLIN	185	B9	POKE	228	E4	STR$
143	8F	VLIN	186	BA	PRINT	229	E5	VAL
144	90	HGR2	187	BB	CONT	230	E6	ASC
145	91	HGR	188	BC	LIST	231	E7	CHR$
146	92	HCOLOR=	189	BD	CLEAR	232	E8	LEFT$
147	93	HPLOT	190	BE	GET	233	E9	RIGHT$
148	94	DRAW	191	BF	NEW	234	EA	MID$
149	95	XDRAW	192	C0	TAB(	235	EB	
150	96	HTAB	193	C1	TO	236	EC	
151	97	HOME	194	C2	FN	237	ED	
152	98	ROT=	195	C3	SPC(	238	EE	
153	99	SCALE=	196	C4	THEN	239	EF	
154	9A	SHLOAD	197	C5	AT	240	F0	
155	9B	TRACE	198	C6	NOT	241	F1	
1561	9C	NOTRACE	199	C7	STEP	242	F2	
157	9D	NORMAL	200	C8	+	243	F3	
158	9E	INVERSE	201	C9	-	244	F4	
159	9F	FLASH	202	CA	*	245	F5	
160	A0	COLOR=	203	CB	/	246	F6	
161	A1	POP	204	CC	^	247	F7	
162	A2	VTAB	205	CD	AND	248	F8	
163	A3	HIMEM:	206	CE	OR	249	F9	
164	A4	LOMEM:	207	CF	>	250	FA	
165	A5	ON ERR	208	D0	=	251	FB	
166	A6	RESUME	209	D1	<	252	FC	
167	A7	RECALL	210	D2	SGN	253	FD	
168	A8	STORE	211	D3	INT	254	FE	
169	A9	SPEED=	212	D4	ABS	255	FF	
170	AA	LET	213	D5	USR			

APPENDIX D

SELECTED REFERENCES

This sections lists a number of articles that have appeared in the following publications:

* Micro
* Call A.P.P.L.E.
* Nibble
* Apple Assembly Line

The first three are well-known magazines, available in most computer stores. Apple Assembly Line is available from S-C Software, P.O. Box 280300, Dallas, Texas, 75228.

Most of these articles contain assembly language programs. Many of these require no modification, or only minor modification, to be usable with the Toolbox system. If a routine can be used without modification, a short description of it is included with the reference.

The references are in order according to date of publication.

"& NOW, THE AMPERSAND", Anon., PEEKing at Call A.P.P.L.E., Vol. 1 (1978).

"& NOW, THE FURTHER ADVENTURES OF THE MYSTERIOUS AMPERSAND", Anon., PEEKing at Call A.P.P.L.E., Vol. 1 (1978).

"APPLE][MACHINE CODE RELOCATION", S. Wozniak, Wozpak][, Call A.P.P.L.E. (Nov 79).

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"APPLESOFT STRING SWAP", R. Wiggington, Call A.P.P.L.E., (Jan 80). Ampersand-invokable machine language routine for interchanging string variables.

"APPLE][PLUS FLOATING POINT UTILITY ROUTINES", H.L. Pruetz, Micro (Mar 80).

"APPLESOFT INTERNAL ENTRY POINTS", J. Crossley, Apple Orchard, (Mar/Apr 80). Reprinted in All About Applesoft, Call A.p.p.l.e. (1981).

"THE &LOMEM: UTILITY", N. Konzen, Apple Orchard (Mar/Apr 80).

"THE RETURN OF THE MYSTERIOUS MR. AMPERSAND", D. Lingwood, Call A.P.P.L.E. (May 80).

"APPLE STRINGS", R. Geiger, Creative Computing (May 80).

"TEXT OUTPUT ON THE APPLE][", R. Wagner, Call A.P.P.L.E. (Jun 80).

"ZOOM & SQUEEZE", G.B. Little, Micro (Jul 80).

"TYPES OF MEMORY MOVES", L. Reynolds, Call A.P.P.L.E. (Jul/Aug 80). Relocatable backwards memory move routine.

"HI-RES SCREEN SWITCH", W. Huntress, Call A.P.P.L.E. (Jul/Aug 80).

"AMPER-INTERPRETER", R.M. Mottola, Nibble (Aug/Sep 80).

"HI-RES SCREEN FUNCTION", K. Manly, Call A.P.P.L.E. (Oct 80).

"LINKING MACHINE LANGUAGE ROUTINES TO APPLESOFT PROGRAMS", Anon., Apple Orchard (Fall 80).

"GENERAL MESSAGE PRINTING ROUTINE", B. Sander-Cederlof, Apple Assembly Line (Oct 80).

"PRINT USING FOR APPLESOFT", G.A. Morris, Micro (Oct 80).

"HOW TO USE THE HOOKS", R. Williams, Micro (Nov 80).

"BASIC/MACHINE LANGUAGE SUBROUTINE CREATOR", D.P. Szetela, Nibble (Nov/Dec 80).

"TWO M/L SOUND EFFECTS PROGRAMS REVISITED", J.P. Davis, The Abacus][(Nov/Dec 80).

"ANIMATION WITH DATA ARRAYS", P. Connelly, Call A.P.P.L.E. (Dec 80).

"MULTIPLYING ON THE 6502", B.W. Boering, Micro (Dec 80).

"A BASIC TO MACHINE LANGUAGE INTERFACE", P. Rowe, Apple Orchard (Winter 80).

"A MACHINE LANGUAGE ADDRESS CALCULATOR", R. Lavallee, Apple Orchard (Winter 80).

"BINARY-TO-DECIMAL SHORTCUT (SMALL IS BEAUTIFUL)", S. Wozniak, Apple Orchard (Winter 80).

"POKE SALAD", T.A. Brown, Apple Orchard (Winter 80). An ampersand-invokable relocatable 150-byte machine language subroutine for displaying dollars and cents.

"SEARCHING STRING ARRAYS", G.B. Little, Micro (Jan 81). Relocatable machine language subroutine to search one dimensional string arrays.

"REAL VARIABLE STUDY", E.E. Goez, Call A.P.P.L.E. (Jan 81).

"APPLESOFT SUB-STRING SEARCH FUNCTION", L. Reynolds, Call A.P.P.L.E. (Jan 81).

"FAST GARBAGE COLLECTION", R. Wiggington, Call A.P.P.L.E. (Jan 81).

"AMPER-READER", A.G. Hill, Nibble (Jan/Feb 81).

"A GENERAL MOVE SUBROUTINE", B. Sander-Cederlof, Apple Assembly Line (Jan 81).

"A COMPUTED GOSUB FOR APPLESOFT", B. Sander-Cederlof, Apple Assembly Line (Jan 81).

"IN THE HEART OF APPLESOFT", C. Bongers, Micro (Feb 81).

"DOS INTERNALS: AN OVERVIEW", M. Pump, Call A.P.P.L.E. (Feb 81).

"APPLE NOISES AND OTHER SOUNDS", B. Sander-Cederlof, Apple Assembly Line (Feb 81).

"A STRING SWAPPER FOR APPLESOFT", B. Sander-Cederlof, Apple Assembly Line (Feb. 81).

"AMPER-SWITCH", B.E. Colley, Nibble (Feb/Mar 81).

"INPUTTING STRINGS WITH COMMAS", R.M. Mottola, Nibble (Feb/Mar 81).

"A BEAUTIFUL DUMP", R.H. Bernard, Apple Assembly Line (Mar 81).

"NOTES ON HI-RES GRAPHICS ROUTINES IN APPLESOFT", C.K. Mesztenyi, Apple Orchard (Spring 81).

"PASSING ARGUMENT VALUES TO MACHINE LANGUAGE SUBROUTINES IN APPLESOFT", C.K. Mesztenyi, Apple Orchard (Spring 81).

"RAPID BUBBLE SORT OF NUMERICAL ELEMENTS USING BASIC/ASL" , L.S. Reich, Micro (Mar 81).

"APPLE MEMORY MAPS, PART 2", P.A. Cook, Micro (May 81).

"APPLESOFT INTERNAL ENTRY POINTS", B. Sander-Cederlof, Apple Assembly Line (Apr 81).

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"BENEATH APPLE DOS", Quality Software, 1981.

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"MACHINE LANGUAGE RANDOM NUMBER GENERATOR", B. Logan, Nibble (Jul/Aug 81).

"TRAPPING THE RESET KEY", G. Little, Nibble (Jul/Aug 81).

"COMMON ARRAY NAMES IN APPLESOFT][", S. Cochard, Micro (Aug 81). Contains ampersand-invokable machine language subroutine for interchanging numerical variables.

"STAND-ALONE RANDOM FUNCTION", B. Sander-Cederlof, Apple Assembly Line (Aug 81).

"FINDING APPLESOFT LINE NUMBERS", R.W. Potts, Apple Assembly Line (Aug 81).

"FIELD INPUT ROUTINE FOR APPLESOFT" R.W. Potts, Apple Assembly Line (Sep 81).

"CHRGET AND CHRGOT IN APPLESOFT", B. Sander-Cederlof, Apple Assembly Line (Sep 81).

"ALL ABOUT APPLESOFT", Call A.P.P.L.E. 1981. Contains numerous assembly language routines amoung the fourteen articles, most of which are likely to be of considerable interest to users of Routine Machine.

"AMPLIFYING APPLESOFT", D. Lingwood, All About Applesoft (1981).

"PRINT USING & FRIENDS", C. Peterson, All About Applesoft (1981).

"ULTIMATE INPUT-ANYTHING ROUTINE", P. Meyer, All About Applesoft (1981).

"WHAT'S WHERE IN THE APPLE?", W.F. Luebbert, Micro Ink, Inc., 1981.

"A SHORT APPLESOFT LINE FINDER ROUTINE", P. Meyer, Micro (Dec 81).

APPENDIX E

USING THE TOOLBOX AND WORKBENCH WITH ProDOS

The Toolbox and Workbench are ready to run with ProDOS.

CONVERTING FILES TO ProDOS: You will need to use Apple's CONVERT program to convert all of the files on the disk to the ProDOS format. You will also have to place a copy of the PRODOS system file as well as the BASIC.SYSTEM file on the disk. After converting your files, you should rename HELLO to STARTUP.

INCOMPATIBLE COMMANDS: Please note that the following Toolbox commands will not work with ProDOS:

BLOAD.TB
BINADR.TB
ERR MSSG.TB (for ProDOS error mssgs)
FREE SECTOR COUNT.TB

The BLOAD command when written for ProDOS do not increase the speed of loading a file. The BINADR and FREE SECTOR COUNT commands are also not needed under ProDOS since ProDOS has the ability to determine this information from BASIC by having the program read the directory into an array.

By the way, ProDOS normally clears all Applesoft variables when you press RESET. This can be a pain when trying to de-bug a program. The RESET ONERR.TB command can come in really handy here. Just use the RESET ONERR command to point RESET to a line that just says "END". Then when you press RESET, you'll just go to BASIC, but with all the variable still intact for examination!

FILE NAMES AND PATHNAMES: You will notice when you have CONVERTed your files, that the file names have been changed. All spaces and symbols (e.g. &, *, #, etc.) have become periods (.). In addition the names have been shortened if they were longer than 16 characters. You may wish to rename the files after conversion.

USE OF WORKBENCH: The Workbench works as it does under DOS 3.3.

THE WIZARD'S TOOLBOX - QUICK REFERENCE LIST

NOTE: This list is provided solely to refresh your memory as to the exact syntax of any given routine. It is assumed you have already read the primary reference section in the manual and are familiar with the routine.

ARRAY1 SEARCH.TB: (pg 10)

```
&"ARYSRCH",array svar (avar) [TO array svar
(aexpr)] ,sexpr, [,avar] [,aexpr] [,aexpr]
&"ARYSRCH",A$(FE),SRCH$
&"ARYSRCH",A$(FE) TO A$(LE),SRCH$,CHAR,BYT,TYP
&"ARYSRCH",A$(FE),SRCH$,,,3
```

ARRAY1 SORT.TB: (pg 14)

```
&"SORT",array svar (avar) TO array svar (avar)
        [,aexpr [,aexpr [,aexpr]]]
&"SORT",A$(FE) TO A$(LE)
&"SORT",A$(FE) TO A$(LE),PSN,LNGTH,SPKR
```

BINADR.TB: (pg 21)

```
&"BINADR",sexpr,avar [,avar]
&"BINADR",NAME$,ADDR
&"BINADR",NAME$,ADDR,LNGTH
```

BLOAD.TB: (pg 22)

```
&"BLOAD",sexpr [,aexpr]
&"BLOAD",NAME$ or &"BLOAD",NAME$,ADDRESS
```

DATA ELEMENT SELECT.TB: (pg 23)

```
&"SELECT",aexpr
&"SELECT",PSN
```

DATA LINE SELECT.TB: (pg 25)

```
&"DATALINE",aexpr
&"DATALINE",LINENUM
```

ERR.TB: (pg 27)

```
&"ERR" [,avar [,avar]]
&"ERR" or &"ERR",CODE or &"ERR",CODE,LINE
```

ERR MSSG.TB: (pg 30)

```
&"MSSG" [,aexpr]
&"MSSG" or &"MSSG",CODE
```

FREE SECTOR COUNT.TB: (pg 32)

```
&"FREE";avar or &"FREE",avar; avar
&"FREE";FREE or &"FREE",DRIVE;FREE
```

```
GOSUB.TB:  (pg 33)
        &"GOSUB",aexpr
        &"GOSUB",LINENUM

GOTO.TB:  (pg 34)
        &"GOTO",aexpr
        &"GOTO",LINENUM

MEMORY MOVE.TB:  (pg 35)
        &"MOVE",aexpr|hexnum,aexpr|hexnum,aexpr|hexnum
        &"MOVE",$2000,$3FFF,$4000
        &"MOVE",AD,AD+4096,$4000
        &"MOVE",$2000,4096,8192

PRINT USING.TB:  (pg 36)
        &"PRINT",sexpr;aexpr [{,aexpr}] [;sexpr] [;]
        &"PRINT","  $.00",2.65*1.05
        &"PRINT",EDIT$,NUM1,NUM2;SUFFIX$;

PTR READ.TB:  (pg 39)
        &"PTRD",aexpr|hexnum,avar
        &"PTRD",ADDR,NUM or &"PTRD",$73,NUM

PTR WRITE.TB:  (pg 40)
        &"PTRWRT",aexpr|hexnum,aexpr|hexnum
        &"PTRWRT",ADDR,NUM or "PTRWRT",$73,$380
        &"PTRWRT",ADDR,$380 or "PTRWRT",$73,NUM

RESET ONERR.TB:  (pg 41)
        &"RESET ERR",aexpr
        &"RESET ERR",ERRCODE

RESET BOOT.TB:  (pg 42)
        &"RESET BOOT"

RESET RUN.TB:  (pg 42)
        &"RESET RUN"

RESTORE AMPERSAND.TB:  (pg 44)
        &"AMP"

ASCII SHAPES.TB:  (pg 50)
        &"ASC",avar
        &"ASC",NUM      {always returns ´95´)

GAME SHAPES.TB:  (pg 51)
        &"DOT",avar
        &"DOT",NUM      {always returns ´5´)
```

```
MISC.SHAPES.TB:  (pg 53)
        &"MISC",avar
        &"MISC",NUM     {always returns ´60´)

SHAPE PRINTER.TB:  (pg 55)
        &"SPRINT",sexpr [,aexpr,aexpr] [;aexpr] [,aexpr]
        &"SPRINT",A$    [,X,Y] [;XI] [,YI]

SOUND EFFECTS.TB:  (pg 57)
        &"SOUND",aexpr,aexpr
        &"SOUND",PITCH,SHAPE

STRING INPUT.TB:  (pg 58)
        &"INPUT",[sexpr;] svar
        &"INPUT",A$ or &"INPUT","PROMPT";A$

STRING SEARCH.TB:  (pg 59)
        &"SEARCH",sexpr,sexpr,avar [,aexpr]
        &"SEARCH",STRNG$,SRCH$,FOUND
        &"SEARCH",STRNG$,SRCH$,F,START

SWAP.TB:  (pg 60)
        &"SWAP",avar,avar
        &"SWAP",X,Y  or &"SWAP",X$,Y$

TEXT OUTPUT.TB:  (pg 61)
        &"TEXT",sexpr [,aexpr] [;]
        &"TEXT",A$ or &"TEXT",A$,80;

TONE.TB:  (pg 63)
        &"TONE" [,aexpr [,aexpr]]
        &"TONE" or &"TONE",PTCH or &"TONE",PTCH,DRTN

TURTLE GRAPHICS.TB / TURTLE GRAPHICS+.TB:  (pg 65)
        &"TG",character [,aexpr(s)]

Commands:

 INIT:   &"TG",I          {MUST BE USED FIRST}

 SET:    &"TG",S,aexpr,aexpr,aexpr
         &"TG",S,X,Y,DIR

 PEN:    &"TG",P,aexpr
         &"TG",P,UPDOWN (UPDOWN = 0 or 1)

 TURN:   &"TG",T,aexpr
         &"TG",T,ANGLE  (makes relative turn)

         &"TG",T,@aexpr
         &"TG",T,@ANGLE (turns to absolute angle)
```

```
MOVE:    &"TG",M,aexpr
         &"TG",M,DIST

CHORD:   &"TG",C,aexpr,aexpr,avar
         &"TG",C,RADIUS,DIR,LNGTH

FIND:    &"TG",F,avar,avar,avar [,avar]
         &"TG",F,X,Y,DIR or &"TG",F,X,Y,DIR,PEN

ARC:     (available in '+' version only)
         &"TG",A,aexpr,aexpr
         &"TG",A,RADIUS,ANGLE

XNUM.TB:  (pg 70)
         &"XNUM",sexpr|aexpr, avar|svar
         &"XNUM",DEC,HEX$ or &"XNUM",HEX$,DEC
```

>> POSSIBLE ERRORS... <<

SYNTAX ERROR....

1) Check syntax for the command you're using.

2) Make sure the ampersand hook-up line (usually line number 1) has been installed and executed prior to the command being used.

SYSTEM HANGS WHEN COMMAND IS USED...

1) Make sure the ampersand hook-up line (usually line number 1) has been installed and executed prior to the command being used.

2) If the command being called involves moving blocks of memory, make sure that the variables specified are appropriate. Also make sure that you are not overwriting critical areas of the Apple's memory such as DOS, zero page, etc.

UNDEFINED FUNCTION ERROR...

1) Check to make sure you are using the same name to call a command as was used when first adding the command. You can use Option #6 to review the names you gave commands as they were added.

FILE NOT FOUND ERROR (When adding a command)...

1) Make sure you have included the '.TB' in the name of the Toolbox file you wish to add.

THE WIZARD'S TOOLBOX™

Assorted Commands for Applesoft

You're writing your own checkbook program to keep track of the family finances. Your program is almost complete, but since Applesoft doesn't have a Print Using command, how are you going to format your numbers for both the screen and printer?

You've spent hours scanning books, magazines and manuals trying to find something that you can use in your program. Nothing seems to work exactly the way **YOU** want, and worse yet, everything is in Applesoft, which means it is slow!

If this sounds familiar, the simple solution is **THE WIZARD'S TOOLBOX**. Just think of it as an **'APPLESOFT PROGRAM CONSTRUCTION SET'™**. With new and powerful commands not available in Applesoft or any language, you decide what you want your program to do, and The Wizard's Toolbox will add a new command to Applesoft to do the work for you. The Wizard's Toolbox gives you the speed of machine language routines and, best of all, it's **EASIER THAN APPLESOFT**! For example, here are some of the many ways you can use the **PRINT USING** command:

100 INPUT N : &"PRINT USING", "EDIT STRING";N

EDIT STRING	YOU TYPE (N)	IT PRINTS
"$, .00	123.4567	$ 123.46
"***,**$.00"	123.45	$***$123.45
" , $.00"	12345.67	$12,345.67
"00/00/00"	120266	12/02/66
"TIME= 0:00"	830	TIME= 8:30

This is just one of **OVER THIRTY** commands that you can use in almost any Applesoft program. **TEXT OUTPUT** will let you specify column width, indentation, line spacing, and manage word breaks for you with just one easy command. **SEARCH** or **SORT** your data quickly, or **BLOAD** screens or files four times faster than Applesoft. Other handy programming commands include computed **GOTO** and **GOSUB**, **ERROR MESSAGES**, **MEMORY MOVE**, **HEX/DEC CONVERT** and more. You can even add both music and sound to your programs with **TONE** and **SOUND EFFECTS.**

Get into Hi-Res graphics with commands such as **TURTLE GRAPHICS**, **SHAPE VIEWER**, and a Hi-Res text printing command. Plus, use any of over 60 special Hi-Res shapes included.

The manual has complete instructions on each command, helpful programming hints and tips, and information on writing your own Toolbox commands. The enclosed disk is packed with programs that demonstrate each and every command.

Finally, for your convenience, The Wizard's Toolbox is **UNLOCKED**, **COPYABLE**, and **HARD DISK COMPATIBLE.**

SYSTEM REQUIREMENTS:
Apple II, II+, IIe or IIc, with DOS 3.3 or ProDos
(Disk commands require DOS 3.3)

Ask your dealer for other Toolbox packages including the Chart 'n Graph Toolbox, The Database Toolbox, and The Video Toolbox.

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